Geotechnical Report

Centinela Solar Transmission Power Line
Imperial County, California

Prepared for:

Power Engineers, Inc.
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October 2011
Revised September 12, 2012

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October 31, 2011
Revised September 12, 2012

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Final Geotechnical Report
Centinela Solar Transmission Line and Drew Switchyard
South side of State Hwy 98 at Westside Main Canal
Calexico, California
LCI Report No. LE11210

Dear Mr. McLenna:

This Final Geotechnical report is provided to amend Landmark's October 2011 geotechnical report which was issued for design and construction of the proposed 4-mile 230kV power transmission line and switchyard located on the south side of State Hwy 98 at the Westside Main Canal approximately 10 miles west of Calexico, California. The Final Geotechnical report addresses the June 1, 2012 and August 29, 2012 comments by SDG&E. The 230 kV transmission line is proposed to extend east-west from the Centinela Solar Facility to the existing north-south 230kV connector line to SDG&E Imperial Valley Substation. The power line route is comprised of BLM desert lands and private agricultural lands. A 230 kV switchyard (Drew Switchyard) is planned to be sited in the agricultural lands at the southeast corner of State Hwy 98 and the Westside Main Canal.

The enclosed report describes the soil engineering investigation and presents our professional opinions regarding geotechnical conditions at the site to be considered in the design and construction of the project.

This executive summary presents ***selected*** elements of our findings and professional opinions. This summary ***does not*** present all details needed for the proper application of our findings and professional opinions. Our findings, professional opinions, and application options are best related ***through reading the full report***, and are best evaluated with the active participation of the engineer of record who developed them. The findings of this study are summarized below:

- Clay soils (CL) of medium to high expansion predominate the switchyard site. Groundwater depth is approximately 3.5 feet below existing ground surface.

- Designs for thin slabs-on-grade must mitigate expansive soil conditions by removal and replacement of upper 3.0 feet of clay soils with non-expansive sands or by special foundation designs (waffle-style slabs).

- The risk of liquefaction induced settlement at the switchyard site and first tangent pole to the west is moderate (estimated settlement of 1½ to 2¾ inches).

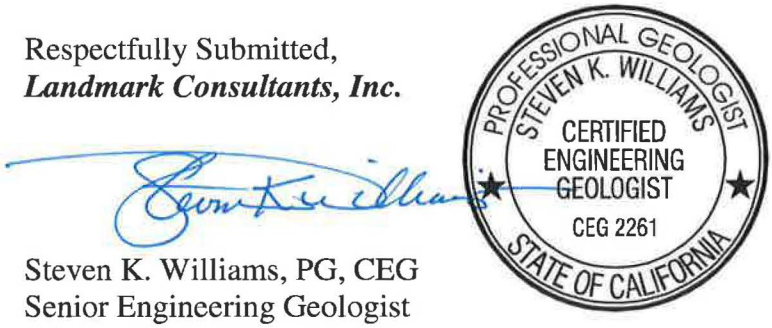
- The clay soils at the switchyard site are aggressive to concrete and steel. Concrete mixes shall have a maximum water cement ratio of 0.45 and a minimum compressive strength of 5,000 psi (minimum of 7 sacks Type II/V cement per cubic yard).

- All reinforcing bars, anchor bolts and hold down bolts shall have a minimum concrete cover of 3.0 inches unless epoxy coated (ASTM D3963/A934).

We did not encounter soil conditions that would preclude development of the switchyard and power pole foundations provided the professional opinions contained in this report are implemented in the design and construction of this project.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. If you have any questions or comments regarding our findings, please call our office at (760) 370-3000.

Respectfully Submitted,
Landmark Consultants, Inc.



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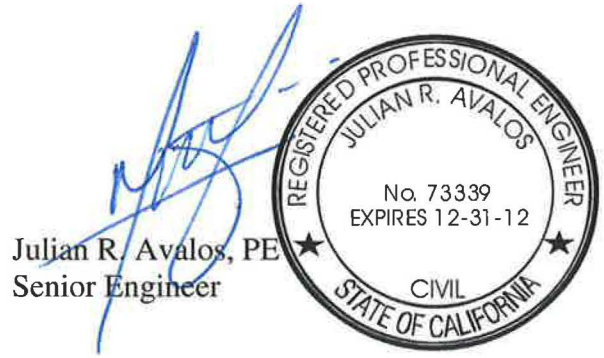

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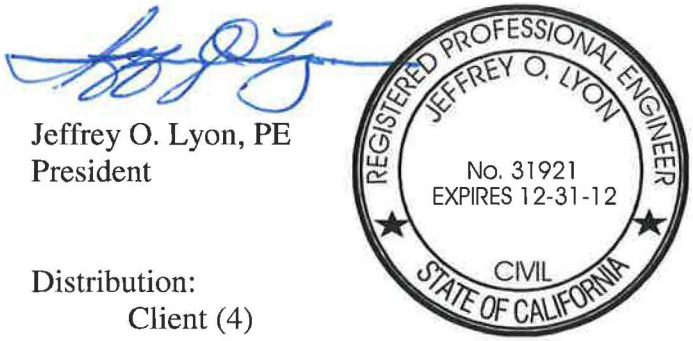

Jeffrey O. Lyon, PE
President

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Section 1
INTRODUCTION

1.1 Project Description

This report presents the findings of our geotechnical investigation for the proposed construction of an approximately 4-mile 230kV power transmission line and electrical switchyard (Drew Switchyard) located on the south side of State Hwy 98 at the Westside Main Canal approximately 10 miles west of Calexico, California. The transmission line is proposed to extend east-west from the Centinela Solar Facility to the existing north-south 230kV connector line to SDG&E Imperial Valley Substation. The power line route is comprised of BLM desert lands and private agricultural lands. The Drew Switchyard is planned to be sited in the agricultural lands at the southeast corner of State Hwy 98 and the Westside Main Canal. A site plan for the proposed switchyard location and power line route was provided by the client prior to our October 2011 investigation. This report incorporates design information relative to the June 1, 2012 comments by SDG&E.

The power line structures are planned to consist of steel monopoles with drilled pier foundations. The electrical switchgear foundation work is planned to consist of drilled shaft concrete foundations for bus supports and switch stands. Mat foundations and/or spread footings are planned for circuit breakers, equipment buildings and miscellaneous equipment. Lateral loads are estimated to range from 0.7 to 19 kips and moments are estimated to range from 8.5 to 369 ft-kips. If structural loads change, we should be notified so we may evaluate their impact on foundation settlement and bearing capacity. The switchyard work will include structure and equipment pads preparation, underground utility installation and concrete foundation placement.

1.2 Purpose and Scope of Work

The purpose of this geotechnical study was to investigate the upper 51.5 feet of subsurface soil at selected locations at the switchyard site and power line route for evaluation of physical/engineering properties. Professional opinions were developed from field and laboratory test data and are provided in this report regarding geotechnical conditions at this site and the effect on design and construction. This Final Geotechnical Report incorporates design criteria relative to the June 1, 2012 comments by SDG&E.

The scope of our services consisted of the following:

- Field exploration and in-situ testing of the site soils at selected locations and depths.
- Laboratory testing for physical and/or chemical properties of selected samples.
- Review of the available literature and publications pertaining to local geology, faulting, and seismicity.
- Engineering analysis and evaluation of the data collected.
- Preparation of this report presenting our findings and professional opinions regarding the geotechnical aspects of project design and construction.

This report addresses the following geotechnical parameters:

- Subsurface soil and groundwater conditions
- Site geology, regional faulting and seismicity, near source factors, and site seismic accelerations
- Liquefaction potential and its mitigation
- Expansive soil and methods of mitigation
- Aggressive soil conditions to metals and concrete

Professional opinions with regard to the above parameters are presented for the following:

- Site grading and earthwork
- Building pad and foundation subgrade preparation
- Allowable soil bearing pressures and expected settlements
- Concrete slabs-on-grade
- Drilled piers and uplift resistance
- Lateral earth pressures
- Excavation conditions and buried utility installations
- Mitigation of the potential effects of salt concentrations in native soil to concrete mixes and steel reinforcement
- Seismic design parameters

Our scope of work for this report did not include an evaluation of the site for the presence of environmentally hazardous materials or conditions, groundwater mounding, or landscape suitability of the soil.

1.3 Authorization

Mr. John Henning of Power Engineers, Inc. provided authorization by written agreement to proceed with our work on September 22, 2011. We conducted our work according to our written proposal dated September 19, 2011. The Final Geotechnical Report amendments were made in response to Mr. Randal Van Ess' July 18, 2012 request to address the June 1, 2012 SDG&E comments.

Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Initial subsurface exploration was performed on September 27, 2011 using Middle Earth Geo-Testing, Inc. of Orange, California to advance three (3) electric cone penetrometer (CPT) soundings to approximate depths of 50 feet below existing ground surface.

The soundings were made at the locations shown on the Site and Exploration Plan (Plate A-2). The approximate sounding locations were established in the field and plotted on the site map by sighting to discernable site features.

CPT soundings provide a continuous profile of the soil stratigraphy with readings every 2.5cm (1 inch) in depth. Direct sampling for visual and physical confirmation of soil properties has been used by our firm to establish direct correlations with CPT exploration in this geographical region.

The CPT exploration was conducted by hydraulically advancing an instrumented Hogentogler $10cm^2$ conical probe into the ground at a rate of 2cm per second using a 23-ton truck as a reaction mass. An electronic data acquisition system recorded a nearly continuous log of the resistance of the soil against the cone tip (Qc) and soil friction against the cone sleeve (Fs) as the probe was advanced. Empirical relationships (Robertson and Campanella, 1989) were then applied to the data to give a continuous profile of the soil stratigraphy. Interpretation of CPT data provides correlations for SPT blow count, phi (ϕ) angle (soil friction angle), undrained shear strength (S_u) of clays and over-consolidation ratio (OCR). These correlations may then be used to evaluate vertical and lateral soil bearing capacities and consolidation characteristics of the subsurface soil.

Additional subsurface exploration was performed on October 3 and 16, 2011 using 2R Drilling of Ontario, California to advance six (6) borings to depths of 41.5 to 51.5 feet below existing ground surface. The borings were advanced with a truck-mounted, CME 55 drill rig using 8-inch diameter, hollow-stem, and continuous-flight augers. The approximate boring locations were established in the field and plotted on the site map by sighting to discernable site features. The boring locations are shown on the Site and Exploration Plan (Plate A-2).

A professional geologist observed the drilling operations and maintained logs of the soil encountered with sampling depths. Soils were visually classified during drilling according to the Unified Soil Classification System and relatively undisturbed and bulk samples of the subsurface materials were obtained at selected intervals. The relatively undisturbed soil samples were retrieved using a 2-inch outside diameter (OD) split-spoon sampler or a 3-inch OD Modified California Split-Barrel (ring) sampler. In addition, Standard Penetration Tests (SPT) was performed in accordance with ASTM D1586. The samples were obtained by driving the samplers ahead of the auger tip at selected depths using a 140-pound CME automatic hammer with a 30-inch drop. The number of blows required to drive the samplers the last 12 inches of an 18-inch drive depth into the soil is recorded on the boring logs as "blows per foot". Blow counts (N values) reported on the boring logs represent the field blow counts. No corrections have been applied to the blow counts shown on the boring logs for effects of overburden pressure, automatic hammer drive energy, drill rod lengths, liners, and sampler diameter. Pocket penetrometer readings were also obtained to evaluate the stiffness of cohesive soils retrieved from sampler barrels.

After logging and sampling the soil, the exploratory borings were backfilled with the excavated material. The backfill was loosely placed and was not compacted to the requirements specified for engineered fill.

Interpretive logs of the CPT soundings and logs of the test borings and test pits were produced after review of field and laboratory test data and are presented on Plates B-1 through B-10 in Appendix B of this report. Keys to the interpretation of CPT soundings, logs of test borings and test pits are presented on Plate B-11 and B-12.

2.2 Laboratory Testing

Laboratory tests were conducted on selected bulk (auger cuttings) and relatively undisturbed soil samples obtained from the soil boring to aid in classification and evaluation of selected engineering properties of the site soils. The tests were conducted in general conformance to the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below.

The laboratory testing program consisted of the following tests:

- Plasticity Index (ASTM D4318) – used for soil classification and expansive soil design criteria
- Particle Size Analyses (ASTM D422) – used for soil classification and liquefaction evaluation
- Unit Dry Densities (ASTM D2937) and Moisture Contents (ASTM D2216) – used for insitu soil parameters
- One Dimensional Consolidation (ASTM D2435) – used for settlement estimates.
- Direct Shear (ASTM D3080) – used for soil strength determination
- Unconfined Compression (ASTM D2166) – used for soil strength estimates.
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods) – used for concrete mix proportions and corrosion protection requirements.

The laboratory test results are presented on the subsurface logs (Appendix B) and on Plates C-1 through C-6 in Appendix C.

Engineering parameters of soil strength, compressibility and relative density utilized for developing design criteria provided within this report were either extrapolated from correlations with the subsurface CPT data or from data obtained from the field and laboratory testing program.

Section 3
DISCUSSION

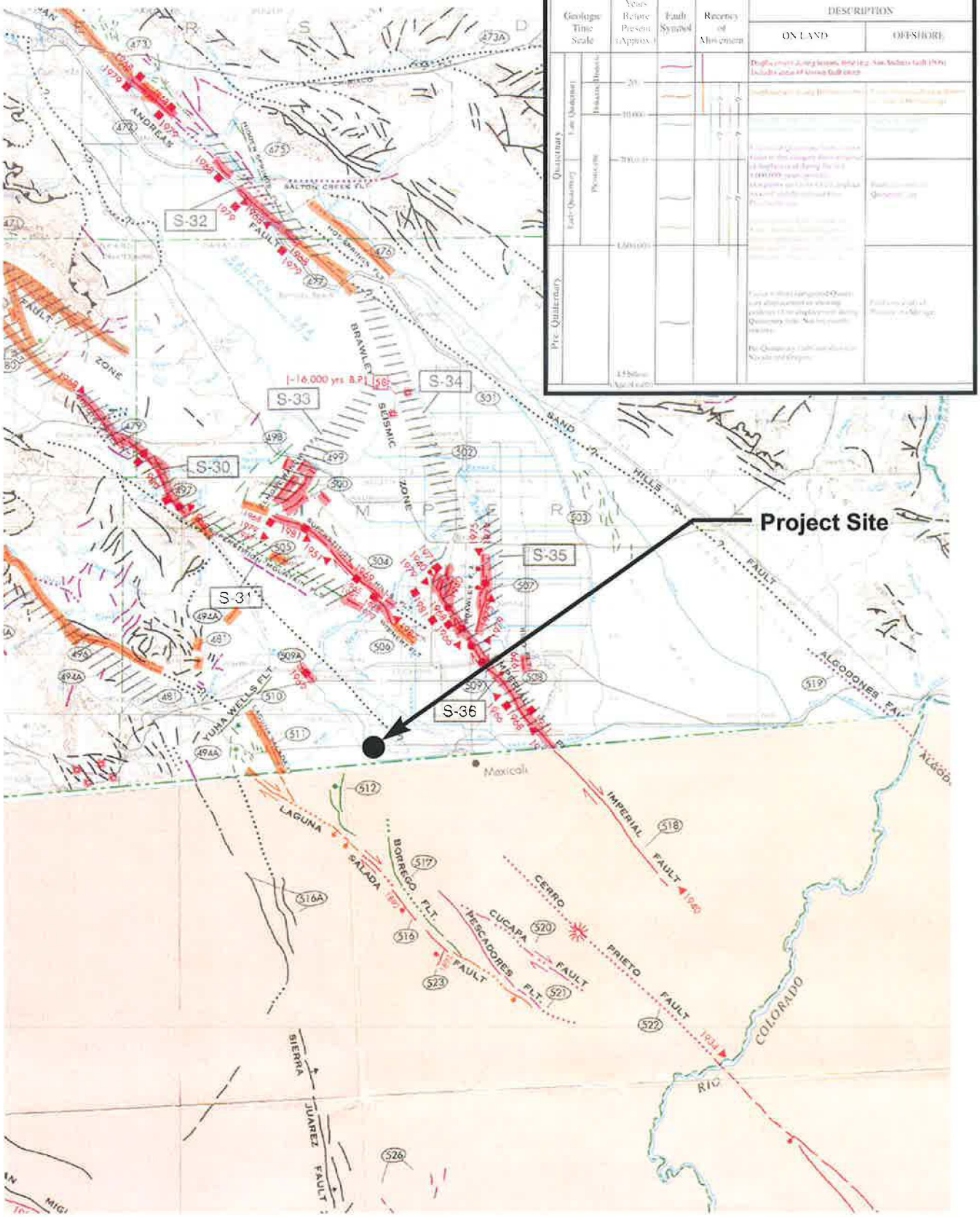
3.1 Site Conditions

The project site is vacant, flat-lying with very little, if any, vegetation covering the site. The powerline route consists of agricultural fields except for the western portion which crosses vacant desert land. The Drew Switchyard site is sporadically covered in weeds and is intermittently used as a hay storage area. The agricultural fields are currently fallow. Adjacent properties are flat-lying and are approximately at the same elevation with this site, consisting of agricultural use lands.

The project site lies at an elevation of approximately 5 to 10 feet below mean sea level (MSL) (El. 995 to 990 local datum) in the Imperial Valley region of the California low desert. The surrounding properties lie on terrain which is flat (planar), part of a large agricultural valley, which was previously an ancient lake bed covered with fresh water to an elevation of 43± feet above MSL. Annual rainfall in this arid region is less than 3 inches per year with four months of average summertime temperatures above 100 °F. Winter temperatures are mild, seldom reaching freezing.

3.2 Geologic Setting

The project site is located in the Imperial Valley portion of the Salton Trough physiographic province. The Salton Trough is a topographic and geologic structural depression resulting from large scale regional faulting. The trough is bounded on the northeast by the San Andreas Fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone. The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments since the Miocene Epoch. Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. Figure 1 shows the location of the site in relation to regional faults and physiographic features.



REFERENCE: Fault Activity Map of California and Adjacent Areas, CGS Data Map Series 6 (Jennings 1994)

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Regional Fault Map

Figure 1

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:

(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.

(b) fault creep slippage – slow ground displacement usually without accompanying earthquakes.

(c) displaced survey lines.

Pink band added to emphasize location of historic fault displacement.

SPECIAL NOTATIONS

A triangle to the right or left of the date indicates termination point of observed surface displacement.

1951▶ ◀1951

Date bracketed by triangles indicates local fault break.

No triangle by date indicates an intermediate point along fault break. 1906

Dot on fault indicates location where fault creep slippage has been observed and recorded.

Square on fault indicates where fault creep slippage has occurred that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points). 1968 1969 1968

Holocene fault displacement (during past 10,000 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting. Pale orange band added to emphasize location of Holocene fault displacement.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.

Late Cenozoic faults within the Sierra Nevada including, but not restricted to, the Foothills fault system. Faults show stratigraphic and/or geomorphic evidence for displacement of late Miocene and Pliocene deposits. By analogy, late Cenozoic faults in this system that have been investigated in detail may have been active in Quaternary time. (Data from PG&E, 1993).

Pre-Quaternary fault (older than 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissance nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

S-25

Fault segment associated with a significant linear trend of accurately located earthquake epicenters (magnitude 0.2 or greater). Generally aligned along strike slip faults having Quaternary displacement, but not necessarily with historic surface rupture. Lack of seismic activity along any fault is no indication that the fault may not be active in the future (e.g. San Andreas fault north of San Francisco). Epicenter data are derived from closely spaced seismic stations and include either continuing microseismicity or aftershocks associated with relatively large earthquakes.

REFERENCE: Fault Activity Map of California and Adjacent Areas, CGS Data Map Series 6 (Jennings 1994)

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Regional Fault Map Legend

Figure 2

The Imperial Valley is directly underlain by lacustrine deposits, which consist of interbedded lenticular and tabular silt, sand, and clay. The Late Pleistocene to Holocene lake deposits are probably less than 100 feet thick and derived from periodic flooding of the Colorado River which intermittently formed a fresh water lake (Lake Cahuilla). Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 - 20,000 feet.

3.3 Seismic Hazards

▸ **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Laguna Salada, Borrego, Pescadores, Superstition Hills, and Cerro Prieto Faults.

▸ **Surface Rupture.** The project site does not lie within a State of California, Alquist-Priolo Earthquake Fault Zone. Surface fault rupture is considered to be unlikely at the project site because of the well-delineated fault lines through the Imperial Valley as shown on USGS and California Geological Survey (CGS) maps.

▸ **Liquefaction.** Liquefaction is a potential design consideration because of underlying saturated sandy substrata. The potential for liquefaction at the site is discussed in more detail in Section 3.8.

Other Secondary Hazards.

▸ **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during our site investigation.

▸ **Volcanic hazards.** The site is not located in proximity to any known volcanically active area and the risk of volcanic hazards is considered very low.

▸ **Tsunamis, seiches, and flooding.** The site is not located near any large bodies of water, so the threat of tsunami, seiches, or other seismically-induced flooding is unlikely. The water level in the Westside Main Canal is at or slightly below the site elevation. The concrete lined Wormwood Canal is elevated approximately 2 to 3 feet above the elevation of the Drew Switchyard site.

There is a concrete farm irrigation water head ditch between the Wormwood Canal and the switchyard site. The potential for flooding of the project site from failure of the Wormwood Canal is discussed in Section 3.8 of this report.

- **Expansive soil.** In general, much of the near surface soils in the Imperial Valley consist of silty clays and clays which are moderate to highly expansive. The expansive soil conditions are discussed in more detail in Section 3.6.

3.4 Faulting and Seismic Risks

Faulting and Seismic Sources: We have performed a computer-aided search of known faults or seismic zones that lie within a 62 mile (100 kilometer) radius of the project site as shown on Figure 1 and Table 1. The search identifies known faults within this distance and computes deterministic ground accelerations at the site based on the maximum credible earthquake expected on each of the faults and the distance from the fault to the site.

Seismic Risk: The project site is located in the seismically active Imperial Valley of southern California and is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. The proposed site structures should be designed in accordance with the 2010 California Building Code (CBC) for a "Maximum Considered Earthquake" (MCE) and with the appropriate site coefficients.

3.5 General Ground Motion Analysis

Site Acceleration: Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Accelerations also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

CBC Seismic Coefficients: The 2010 CBC general ground motion parameters are based on the Maximum Considered Earthquake for a ground motion with a 2% probability of occurrence in 50 years.

Table 1
Summary of Characteristics of Closest Known Active Faults

Fault Name	Fault Type	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Laguna Salada	A	5.7	9.1	7	67 ± 7	3.5 ± 1.5
Dixieland *		5.9	9.5			
Superstition Hills	A	10.8	17.2	6.6	23 ± 2	4 ± 2
Yuha Well *		11.4	18.2			
Superstition Mountain	A	14.3	22.9	6.6	24 ± 2	5 ± 3
Imperial	A	14.6	23.3	7	62 ± 6	20 ± 5
Brawley *		15.5	24.9			
Cerro Prieto *		17.5	28.0			
Rico *		17.8	28.5			
Elsinore - Coyote Mountain	A	22.2	35.6	6.8	39 ± 4	4 ± 2
Elmore Ranch	B	26.5	42.4	6.6	29 ± 3	1 ± 0.5
San Jacinto - Borrego	A	29.9	47.8	6.6	29 ± 3	4 ± 2
Algodones *		43.8	70.0			
San Andreas - Coachella	A	46.6	74.5	7.2	96 ± 10	25 ± 5
San Jacinto - Anza	A	47.9	76.6	7.2	91 ± 9	12 ± 6
Hot Springs *		48.3	77.3			
Elsinore - Julian	A	48.6	77.8	7.1	76 ± 8	5 ± 2
San Jacinto - Coyote Creek	A	49.1	78.5	6.8	41 ± 4	4 ± 2
Earthquake Valley	B	51.6	82.5	6.5	20 ± 2	2 ± 1

* Note: Faults not included in CGS database.

The U.S. Geological Survey "Earthquake Ground Motion Tool", version 5.0.9a (USGS, 2009) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters shown in Table 2.

The site soils have been classified as Site Class D (stiff soil profile). Design earthquake ground motions are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE ground motions. Design earthquake ground motion data are provided in Table 2.

A ground motion value of 0.38g (S_{DS}/2.5) was determined for liquefaction and seismic settlement analysis in accordance with 2010 CBC Section 1803.5.12 and CGS Note 48. The parameter S_{DS} is derived from the maximum considered earthquake spectral response acceleration for short periods (CBC Section 1613.5.4).

The site has potentially liquefiable soils and may be considered as having Site Class F soils. Design ground motions and Maximum Considered (MCER) Response Spectrum has been determined for the site in accordance with ASCE 7-10 using the web-based U.S. Seismic Design Maps Web Application.

Site Class F was considered for this project. When Site Class F is utilized, a site response analysis is required to be made in accordance with Section 21.1 of ASCE 7-10. For Site Class F sites, Section 21.1.1 states that a MCE_R response spectrum shall be developed for bedrock using the procedure of Section 11.4.6 assuming Site Class B and multiplying the design response spectrum by 1.5. Site Class B has a lower F_v value (1.0 versus 1.5), resulting in lower long period values than would be determined for Site Class D. This is less conservative that using Site Class D. Therefore, we provided a MCE_R response spectrum using Site Coefficient values for Site Class D. Results are presented in Table 2a.

Table 2
2010 California Building Code (CBC) and ASCE 7-5 Seismic Parameters

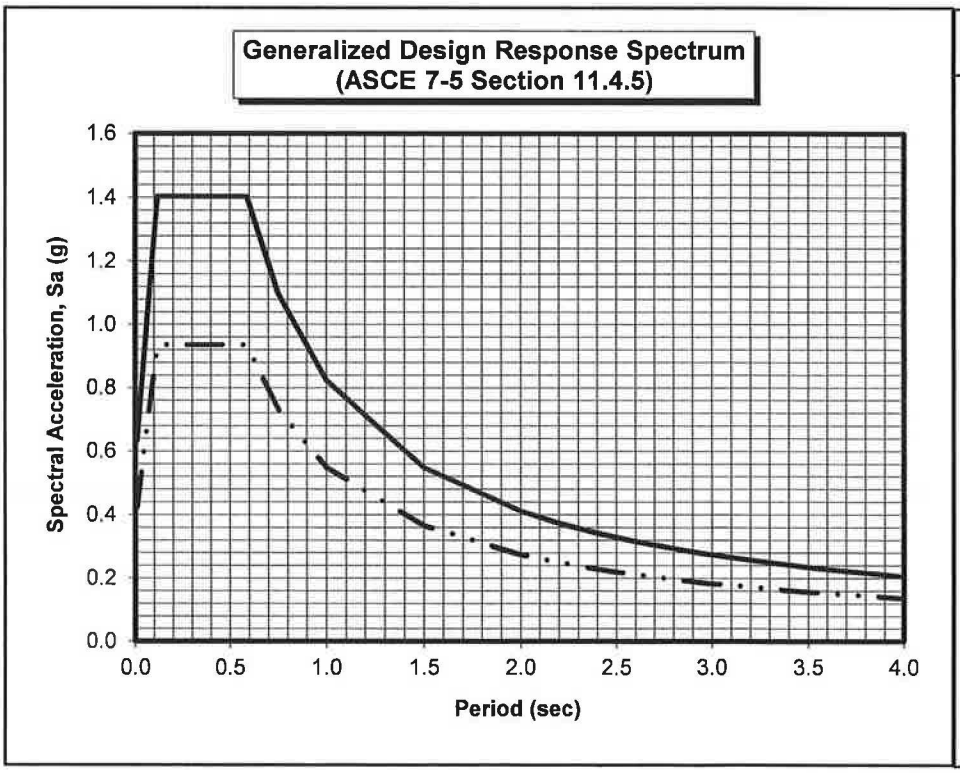
		CBC Reference
Site Class:	D	Table 1613.5.2
Latitude:	32.6780 N	
Longitude:	-115.6714 W	

Maximum Considered Earthquake (MCE) Ground Motion

Short Period Spectral Response	S_s	1.40 g	Figure 1613.5(3)	
1 second Spectral Response	S_1	0.55 g	Figure 1613.5(4)	
Site Coefficient	F_a	1.00	Table 1613.5.3 (1)	
Site Coefficient	F_v	1.50	Table 1613.5.3 (2)	
Adjusted Short Period Spectral Response	S_{MS}	1.40 g	$= F_a * S_s$	Equation 16-36
Adjusted 1 second Spectral Response	S_{M1}	0.82 g	$= F_v * S_1$	Equation 16-37

Design Earthquake Ground Motion

Short Period Spectral Response	S_{DS}	0.94 g	$= 2/3*S_{MS}$	Equation 16-38
1 second Spectral Response	S_{D1}	0.55 g	$= 2/3*S_{M1}$	Equation 16-39
	To	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	Ts	0.59 sec	$=S_{D1}/S_{DS}$	



2010 CBC

Period T (sec)	Sa (g)	MCE Sa (g)	80% Sa (g)
0.01	0.42	0.63	0.34
0.03	0.52	0.78	0.41
0.10	0.85	1.28	0.68
0.12	0.94	1.40	0.75
0.15	0.94	1.40	0.75
0.20	0.94	1.40	0.75
0.30	0.94	1.40	0.75
0.40	0.94	1.40	0.75
0.50	0.94	1.40	0.75
0.59	0.94	1.40	0.75
0.75	0.73	1.10	0.59
1.00	0.55	0.82	0.44
1.50	0.37	0.55	0.29
2.00	0.27	0.41	0.22
2.20	0.25	0.37	0.20
2.40	0.23	0.34	0.18
2.60	0.21	0.32	0.17
2.80	0.20	0.29	0.16
3.00	0.18	0.27	0.15
3.50	0.16	0.24	0.13
4.00	0.14	0.21	0.11

Design Response Spectra
MCE Response Spectra

Table 2a
ASCE 7-10 Seismic Parameters

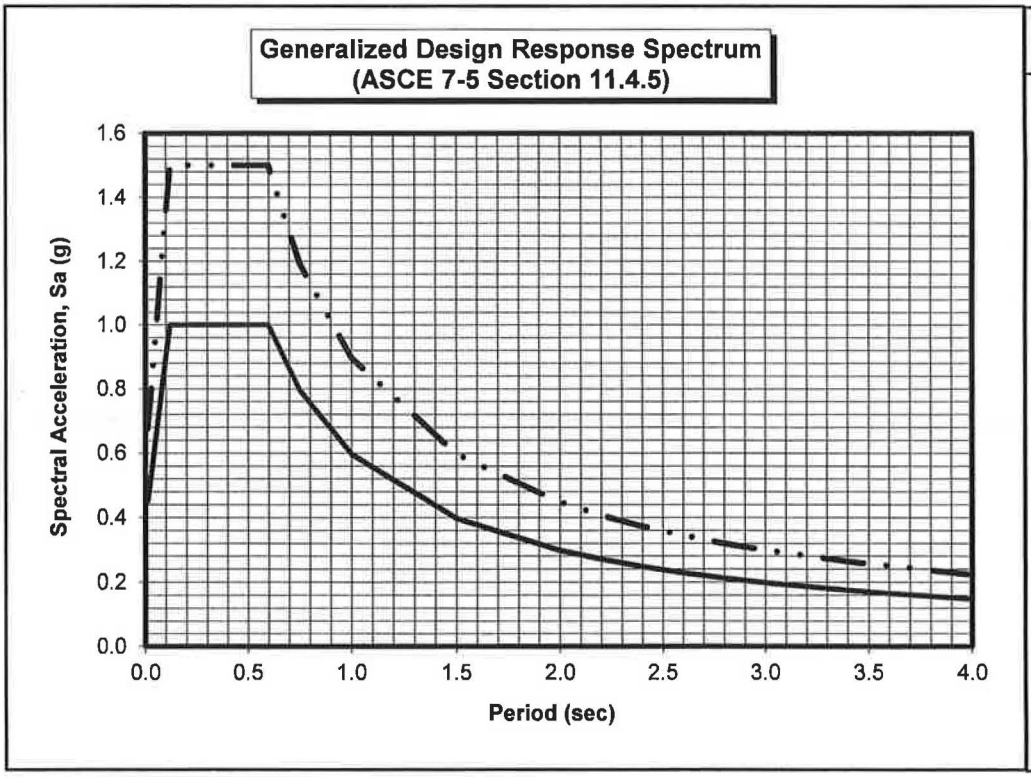
Site Class: **D** Table 20.3-1
Latitude: 32.6780 N
Longitude: -115.67 W

Maximum Considered Earthquake (MCE) Ground Motion

MCE_R Short Period Spectral Response	S_s	1.50 g	Figure 22-1	
MCE_R 1 second Spectral Response	S_1	0.60 g	Figure 22-2	
Short Period (0.2 s) Site Coefficient	F_a	1.00	Table 11.4-1	
Long Period (1.0 s) Site Coefficient	F_v	1.50	Table 11.4-2	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.50 g	$= F_a * S_s$	Equation 11.4-1
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	0.90 g	$= F_v * S_1$	Equation 11.4-2

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.00 g	$= 2/3*S_{MS}$	Equation 16-38
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.60 g	$= 2/3*S_{M1}$	Equation 16-39
	T_L	8.00 sec		Figure 22-12
	T_O	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.60 sec	$=S_{D1}/S_{DS}$	



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.01	0.45	0.68
0.03	0.55	0.83
0.10	0.90	1.35
0.12	1.00	1.50
0.15	1.00	1.50
0.20	1.00	1.50
0.30	1.00	1.50
0.40	1.00	1.50
0.50	1.00	1.50
0.60	1.00	1.50
0.75	0.80	1.19
1.00	0.60	0.90
1.50	0.40	0.60
2.00	0.30	0.45
2.20	0.27	0.41
2.40	0.25	0.37
2.60	0.23	0.34
2.80	0.21	0.32
3.00	0.20	0.30
3.50	0.17	0.26
4.00	0.15	0.22

Design Response Spectra
MCE_R Response Spectra

3.6 Subsurface Soil

Subsurface soils encountered during the field exploration conducted on September 27, October 3, and October 16, 2011 consist of interbedded sands silts and clays of various thicknesses and depths. The near surface soils east of the switchyard area consist of expansive clays and the soils west of the switchyard consist predominantly of silty sands. The subsurface logs (Plates B-1 through B-10) depict the stratigraphic relationships of the various soil types.

The native surface clays likely exhibit moderate to high swell potential (Expansion Index, EI = 7o to 130) when correlated to Plasticity Index tests (ASTM D4318) performed on the native clays (PI = 30 to 45). The clay is expansive when wetted and can shrink with moisture loss (drying). Development of structure foundations, concrete flatwork, and asphaltic concrete pavements should include provisions for mitigating potential swelling forces and reduction in soil strength, which can occur from saturation of the soil. Typical measures considered to remediate expansive soil include:

- capping silt/clay soil with a non-expansive sand layer of sufficient thickness to reduce the effects of soil shrink/swell
- removal and replacement of the expansive clay soils with non-expansive granular soil.
- design of foundations that are resistant to shrink/swell forces of silt/clay soil

3.7 Groundwater

Boring B-5 at the switchyard area was left open after drilling to allow groundwater depth readings. Groundwater was encountered in the boring at about 3.5 feet after 6 hours. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, and site grading. A groundwater level of 3 feet below existing ground surface should be anticipated for site design.

Soils encountered below 2 feet are likely to pump under construction wheel loads. Light earthmoving equipment and geotextile fabric stabilization should be anticipated for use in the switchyard area.

3.8 Liquefaction

Liquefaction occurs when granular soil below the water table is subjected to vibratory motions, such as produced by earthquakes. With strong ground shaking, an increase in pore water pressure develops as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases and the soil behaves as a liquid (similar to quicksand). Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations.

Four conditions are generally required for liquefaction to occur:

(1) the soil must be saturated (relatively shallow groundwater);
(2) the soil must be loosely packed (low to medium relative density);
(3) the soil must be relatively cohesionless (not clayey); and
(4) groundshaking of sufficient intensity must occur to function as a trigger mechanism.

All of these conditions exist to some degree at this site.

Methods of Analysis: Liquefaction potential at the project site was evaluated using the 1997 NCEER Liquefaction Workshop methods. The 1997 NCEER methods utilize direct SPT blow counts or CPT cone readings from site exploration and earthquake magnitude/PGA estimates from the seismic hazard analysis. The resistance to liquefaction is plotted on a chart of cyclic shear stress ratio (CSR) versus a corrected blow count $N_{1(60)}$ or Qc_{1N}. A ground acceleration of 0.40g (40% of the five-percent damped design spectral response acceleration at short periods) was used in the analysis with a 3.5-foot groundwater depth.

Liquefaction induced settlements have been estimated using the 1987 Tokimatsu and Seed method. The fine content of liquefiable sands and silts increases the liquefaction resistance in that more ground motion cycles are required to fully develop increased pore pressures. Prior to calculating the settlements, the field SPT blow counts were corrected to account for the type of hammer, borehole diameter, overburden pressure and rod length $N_{1(60)}$ in accordance with Robertson and Wride (1997).

The CPT tip pressures (Qc) were adjusted to an equivalent clean sand pressure (Q_{CINcs}). The corrected blow counts were then converted to equivalent clean sand blow counts ($N_{1(60)cs}$).

The soil encountered at the points of exploration included saturated silts and silty sands that could liquefy during a CBC Design Basis Earthquake. Liquefaction can occur within several isolated silt and sand layers between depths of 5 to 42.5 feet. The likely triggering mechanism for liquefaction appears to be strong groundshaking associated with the rupture of the Laguna Salada, Borrego, Pescadores, Superstition Hills, and Cerro Prieto Faults. The analysis is summarized in the table below.

TABLE 3: SUMMARY OF LIQUEFACTION ANALYSES

Boring Location	Depth To First Liquefiable Zone (ft)	Potential Induced Settlement (in)
B-1	9.5	½
B-2	---	0
B-3	23.0	1½
B-4	26.0	1½
B-5	8.0	2
B-6	7.0	2¾
B-7	---	0
CPT-1	5.0	2¼
CPT-2	5.5	1¼
CPT-3	9.5	2¼

Liquefaction Induced Settlements: ***Based on empirical relationships, total induced settlements are estimated to be about 1¼ to 2¾ inches should liquefaction occur.*** The magnitude of potential liquefaction induced differential settlement is estimated at be two-thirds of the total potential settlement in accordance with California Special Publication 117; therefore, **there is a potential for up to 1½ inches of liquefaction induced differential settlement at the switchyard site over a horizontal distance of 100 feet.**

Liquefaction Induced Ground Failure: Based on research from Ishihara (1985) and Youd and Garris (1995) ground rupture or sand boil formation is possible because of the relatively thin layer of the overlying unliquefiable soil. Sand boils are conical piles of sand derived from the upward flow of groundwater caused by excess porewater pressures created during strong ground shaking. Sand boils are not inherently damaging by themselves, but are an indication that liquefaction occurred at depth (Jones, 2003).

The concrete lined Wormwood Canal is located between the project site and the Westside Main Canal and is elevated approximately 2 to 3 feet above the elevation of the switchyard site. There is a concrete farm irrigation water head ditch between the Wormwood Canal and the switchyard site. Portions of the **east** embankment of the Westside Main Canal south of the switchyard site experienced liquefaction and lateral spreading during the $7.2M_W$ April 4, 2010 El Mayor-Cucapah Earthquake. Evidence of lateral spreading was not noted along the Wormwood Canal adjacent to the project site.

According to Youd (2005), if the liquefiable layer lies at a depth greater that about twice the height of a free face, lateral spread is not likely to develop. The liquefiable layer nearest the Wormwood Canal was encountered at a depth of 8 feet (Boring B-5) which is greater than 2 times the height (2 to 3 feet) of the free face of the Wormwood Canal embankment. Liquefaction induced lateral spreading is not expected to occur at at the Wormwood Canal embankment adjacent to the site due to the depth of the liquefiable layer.

Mitigation: Ground improvement methods are available to mitigate liquefaction such as deep soil mixing (cement), vibro-compaction, vibro-replacement, geopiers, stone columns, compaction grouting, or deep dynamic compaction. Other means to mitigate liquefaction damage include either a deep foundation system, rigid mat foundations and grade-beam reinforced foundations that can withstand some differential movement or tilting, but may not protect fracturing of buried utilities.

Because of the potential for differential settlement upon liquefaction, the designer may consider some elements of the switchyard structures to be founded on:

1) Foundations that use grade-beam footings to tie floor slabs and isolated columns to continuous footings (conventional or post-tensioned).

2) Structural flat-plate mats, either conventionally reinforced or tied with post-tensioned tendons.

These alternatives reduce the potential effects of liquefaction-induced settlements by making the structures more able to withstand differential settlement. Independent switches and busses may not be sensitive to differential settlements due to lack of structural ties to adjacent equipment.

Section 4
RECOMMENDATIONS

4.1 Switchyard Site Preparation

Clearing and Grubbing: All surface improvements, debris or vegetation including grass, trees, and weeds on the site at the time of construction should be removed from the construction area. Root balls should be completely excavated. Organic strippings should be stockpiled and not used as engineered fill. All trash, construction debris, concrete slabs, old pavement, landfill, and buried obstructions such as old foundations and utility lines exposed during rough grading should be traced to the limits of the foreign material by the grading contractor and removed under our supervision. Any excavations resulting from site clearing should be sloped to a bowl shape to the lowest depth of disturbance and backfilled under the observation of the geotechnical engineer's representative.

Subgrade Preparation for Switchyard Engineered Pad Foundations: The engineered pad shall conform to SDG&E requirements for substations. The native soil within the switchyard area should be removed to a minimum depth of 12 inches below existing ground surface. The exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to 2 to 7% above optimum moisture content, and recompacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

It is possible that wet sandy soils will pump under equipment loads at the project site due to high groundwater levels. Light earthmoving and compaction equipment should be planned for compacting soil at 2 feet below ground surface.

If pumping soils are encountered, a geotextile separation fabric and geogrid layer should be placed over the graded surface and a minimum of 16 inches of aggregate base placed over the geotextile and geogrids prior to allowing any construction equipment onto the engineered pad. The surface of the aggregate base shall be compacted to a minimum of 90% of ASTM D1557 maximum density prior to placing a subsequent 6 inch lift of aggregate base. The geotextile shall a 6 oz. non-woven fabric equivalent to Mirafi 160N or Propex 4506. Geogrids shall be either Tensar TriAx 5 or Tenax MS330. The 6 inch lift of aggregate base shall be compacted to at least 95% of ASTM D1557 maximum density.

A 12 inch layer of Select Fill material, placed in maximum 8-inch lifts (loose), compacted to a minimum of 90% of ASTM D1557 maximum density at ±2% of optimum moisture shall be placed in the bottom of the excavation. A second 24-inch layer of Select Fill material placed in maximum 8-inch lifts (loose) compacted to a minimum of 95% of ASTM D1557 maximum density at ±2% of optimum moisture shall be placed over the first layer. The engineered pad shall be capped with a 12-inch layer of Caltrans Class 2 aggregate base placed in maximum 8-inch lifts (loose), compacted to a minimum of 95% of ASTM D1557 maximum density at ±2% of optimum moisture. The Select Fill material shall be a non-expansive material; well graded particle size distribution with a fines content not exceeding 35% and with no material greater than 3-inch maximum dimension; an Expansion Index less than 20; and a Plasticity Index less than 15.

Observation and Density Testing: All site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area.

The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "*geotechnical engineer of record*" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the recommendations for site development.

4.2 Foundations and Settlements

Structural concrete mat foundations may be designed using an allowable soil bearing pressure of 2,500 psf when the foundation is supported on the engineered pad prepared in accordance with Section 4.1 of this report.. The allowable soil pressure may be increased by one-third for short term loads induced by winds or seismic events. Recommendations for these mat foundations are provided below.

Flat Plate Structural Mats: The structural mat shall have a double mat of steel and a minimum thickness of 12 inches. Structural mats may be designed for a modulus of subgrade reaction (Ks) of 300 pci when a 5 foot engineered pad is used as described in Section 4.1. An allowable friction coefficient of 0.35 may also be used at the base of the mat to resist lateral sliding.

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 300 pcf for select fill to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.35 for select fill may also be used at the base of the footings to resist lateral loading.

Foundation movement under the estimated static (non-seismic) loadings and static site conditions are estimated to not exceed 1 inch with differential movement of about two-thirds of total movement for the loading assumptions stated above when the subgrade preparation guidelines given above are followed. Seismically induced liquefaction settlement of the surrounding land mass and structure may be on the order of up to 2¾ inches.

MFAD and L-Pile Soil Parameters: The switch stands, bus supports and dead end frames may be supported on cast-in-place, drilled piers. Interpretive soil parameters of the subsurface soil for EPRI MFAD and L-Pile Computer Programs are presented in the tables below for each boring location at the switchyard area for cast-in-place, drilled pier design:

TABLE 4: Soil Strength Parameters @ Boring B3 for MFAD and L-Pile Programs

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Modulus of Subgrade Reaction (pci)	E50 or Dr
CH	0 to 6.5	125	0°	0.60	0.40	100	1.30
SM	6.5 to 11	115	32°	0.00	1.40	50	45.0
CL	11 to 23	125	0°	1.00	0.80	300	0.85
ML/CL	23 to 33	120	26°	0.25	0.55	250	0.95
CH	33 to 37	125	0°	0.80	0.60	225	1.00
SC	37 to 41.5	120	26°	0.25	0.80	300	0.85

TABLE 5: Soil Strength Parameters @ Boring B4 for MFAD and L-Pile Programs

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Modulus of Subgrade Reaction (pci)	E50 or Dr
CH	0 to 6.5	125	0°	0.50	0.40	65	1.45
SM	6.5 to 13	115	32°	0.00	1.70	65	55.0
CL	13 to 26	125	0°	1.00	1.00	300	0.85
ML	26 to 31	120	26°	0.25	0.60	300	0.85
CL	31 to 34	125	0°	1.00	1.00	300	0.85
SM	34 to 37	115	30°	0.00	0.70	25	30.0
CL	37 to 41	125	0°	1.00	0.80	300	0.85
SM	41 to 44	115	32°	0.00	1.50	50	50.0
SP	44 to 51.5	120	35°	0.00	4.00	150	80.0

TABLE 6: Soil Parameters @ Boring B5 for MFAD and L-Pile Programs

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Modulus of Subgrade Reaction (pci)	E50 or Dr
CL	0 to 6.5	125	0°	1.00	0.80	300	0.85
SM	6.5 to 15	115	30°	0.00	0.65	25	25.0
CL	15 to 28	125	0°	1.00	0.80	300	0.85
ML	28 to 31	120	26°	0.25	0.60	300	0.85
CH	31 to 38	125	0°	1.00	0.90	300	0.85
SM	38 to 44	115	30°	0.00	0.70	25	30.0
SP	44 to 47	120	35°	0.00	4.00	150	80.0
SM	47 to 51.5	120	36°	0.00	4.50	175	90.0

***Installation*:** The drilled pier shall be placed in conformance to ACI 336 guidelines. Excavation for piers should be inspected by the geotechnical consultant. The bottom of the excavation for piers should be reasonably free of loose or slough material. A tremie pipe should be used to place concrete from the bottom up and to ensure less than five feet of free fall. All drilled piers extending below groundwater shall be cased to prevent caving or lateral deformation. Steel reinforcement and concrete shall be placed immediately after drilling.

Due to the presence of high groundwater and granular soils below groundwater, all drilled piers of greater depth than 6 feet shall be cased in its entire depth to prevent caving or lateral deformation. Groundwater is encountered at a depth of approximately 3.5 feet. The structural steel and concrete should be placed immediately after drilling. Prior to placing any structural steel or concrete, loose soil or slough material should be removed from the bottom of the drilled pier excavation.

Loose and medium dense silt and silty sand layers were encountered at a depth between 5 to 44 feet. Those layers are predicted to liquefy during strong seismic events and may be settle up to 2¼ inches. We recommend embedding the piers to a minimum depth of 20 feet which will reduce the estimated liquefaction settlements to less than 1.5 inches.

Axial Load Group Effect: Reduction in axial load capacity shall be considered necessary for group effect. The axial load capacity shall be reduced by an efficiency factor, η. Efficiency factor, η should be 0.65 for shafts with spacing center to center equal to 2.5 shaft diameters and increases linearly to 1.0 for shafts with center to center spacing equal to 6.0 shaft diameters or more. The factor of safety of the group is the same as that of individual shaft elements.

Lateral Load Group Effect: Group action should be considered when the pier spacing in the direction of loading is less than 6 to 8 pile diameters. Reduction in lateral loading for pier group action can be evaluated by reducing the effective Modulus of Soil Reaction in the direction of loading by a reduction factor R, as follow:

Table 7: Lateral Load Reduction Factors for Group Action

Pile Spacing in Direction of Loading D=Pile Diameter	Reduction Factor, R
8D	1.00
6D	0.70
4D	0.40
3D	0.25

4.3 Slabs-On-Grade

Concrete slabs and flatwork placed over native clay soil should be designed in accordance with Chapter 18 of the 2010 CBC and shall be a minimum of 5 inches thick due to expansive soil conditions (unless a minimum 3.0 foot thick layer of non-expansive soil underlays the slab-on-grade). A swell pressure of 1,500 to 2,000 psf has been estimated for the subsurface native clay soils at the substation site.

Concrete slab and flatwork reinforcement should consist of chaired rebar slab reinforcement (minimum of No. 4 bars at 18-inch centers, both horizontal directions) placed at slab mid-height to resist potential swell forces and cracking. Slab thickness and steel reinforcement are minimums only and should be verified by the structural engineer/designer knowing the actual project loadings. All steel components of the foundation system should be protected from corrosion by maintaining a 3-inch minimum concrete cover of densely consolidated concrete at footings (by use of a vibrator).

All independent flatwork (housekeeping slabs) should be placed on a minimum of 2 inches of concrete sand or aggregate base, dowelled to the perimeter foundations where adjacent to the building to prevent separation and sloped 1 to 2% away from the building.

4.4 Drilled Pier Foundations

The steel power poles are planned be supported on cast-in-place, drilled piers. Interpretive soil parameters of the subsurface soil for EPRI MFAD and L-Pile Computer Programs are presented in the tables below for each boring location along the power line route.

TABLE 8: Drilled Pier Soil Parameters @ Boring B1

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Modulus of Subgrade Reaction (pci)	E50 or Dr
CL	0 to 9.5	125	0°	0.85	0.60	170	1.10
ML	9.5 to 13	120	26°	0.30	0.40	135	1.20
CL	13 to 29	125	0	1.00	0.80	300	0.85
SM	29 to 38	115	32°	0.00	1.70	65	55
CL	38 to 46	125	0	1.50	1.60	500	0.55
ML	46 to 48	120	26°	0.00	0.80	50	45
SM/CL	48 to 51.5	120	26°	0.25	0.70	200	1.00

TABLE 9: Drilled Pier Soil Parameters @ Boring B2

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Modulus of Subgrade Reaction (pci)	E50 or Dr
CL	0 to 8	125	0°	1.00	0.80	300	0.85
SM	8 to 10	115	32°	0.00	1.40	50	45
CL	10 to 13	125	0°	1.00	0.80	300	0.85
SM/CL	13 to 19	120	26°	0.25	1.10	400	0.75
CH	19 to 44	125	0°	1.25	1.00	400	0.75
SC	44 to 48	120	26°	0.25	1.20	500	0.55
SM	48 to 51.5	115	32°	0.00	1.70	65	55

TABLE 10: Drilled Pier Soil Parameters @ Boring B6

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Modulus of Subgrade Reaction (pci)	E50 or Dr
SM	0 to 13	120	30°	0.00	0.55	25	25
CL	13 to 19	125	0°	1.25	1.00	400	0.75
SM/CL	19 to 27	120	26°	0.40	0.50	150	1.10
ML	27 to 36	115	26°	0.25	0.50	225	1.00
CL	36 to 44	125	0°	1.00	0.80	300	0.85
SM	44 to 47.5	115	32°	0.00	1.70	65	55
SM	47.5 to 51.5	115	34°	0.00	3.00	100	65

TABLE 11: Drilled Pier Soil Parameters @ Boring B7

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Modulus of Subgrade Reaction (pci)	E50 or Dr
SM	0 to 7	120	32°	0.00	1.50	75	45
CH	7 to 9	125	0°	1.50	1.60	500	0.55
SM	9 to 18	115	32°	0.00	1.70	60	55
SM	18 to 51.5	115	35°	0.00	4.00	150	80

***Installation*:** The drilled pier shall be placed in conformance to ACI 336 guidelines. Excavation for piers should be inspected by the geotechnical consultant. The bottom of the excavation for piers should be reasonably free of loose or slough material. A tremie pipe should be used to place concrete from the bottom up and to ensure less than five feet of free fall. All drilled piers extending below groundwater shall be cased to prevent caving or lateral deformation. Steel reinforcement and concrete shall be placed immediately after drilling.

Due to the presence of high groundwater and granular soils below groundwater, all drilled piers of greater depth than 6 feet shall be cased in its entire depth to prevent caving or lateral deformation. Groundwater is encountered at a depth of approximately 3.0 feet at the substation site. The structural steel and concrete should be placed immediately after drilling. Prior to placing any structural steel or concrete, loose soil or slough material should be removed from the bottom of the drilled pier excavation.

Axial Load Group Effect: Reduction in axial load capacity shall be considered necessary for group effect. The axial load capacity shall be reduced by an efficiency factor, η. Efficiency factor, η should be 0.65 for shafts with spacing center to center equal to 2.5 shaft diameters and increases linearly to 1.0 for shafts with center to center spacing equal to 6.0 shaft diameters or more. The factor of safety of the group is the same as that of individual shaft elements.

Lateral Load Group Effect: Group action should be considered when the pier spacing in the direction of loading is less than 6 to 8 pile diameters. Reduction in lateral loading for pier group action can be evaluated by reducing the effective Modulus of Soil Reaction in the direction of loading by a reduction factor R, as follow:

Table 7: Lateral Load Reduction Factors for Group Action

Pile Spacing in Direction of Loading D=Pile Diameter	Reduction Factor, R
8D	1.00
6D	0.70
4D	0.40
3D	0.25

4.5 Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plate 8). The native soils were found to have low to severe levels of sulfate ion concentration (0 to 5,280 ppm). Sulfate ions in high concentrations can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. The California Building Code recommends that increased quantities of Type II Portland Cement be used at a low water/cement ratio when concrete is subjected to moderate sulfate concentrations. Type V Portland Cement and/or Type II/V cement with 25% flyash replacement is recommended when the concrete is subjected to soil with severe sulfate concentration.

A minimum of 7.0 sacks per cubic yard of concrete (5,000 psi) of Type V Portland Cement with a maximum water/cement ratio of 0.45 (by weight) should be used for concrete placed in contact with native soil on this project (site-work including sidewalks, driveways, and foundations). Admixtures may be required to allow placement of this low water/cement ratio concrete. No chloride based set accelerators shall be used.

The native soil has low to very severe levels of chloride ion concentration (30 to 2,380 ppm). Chloride ions can cause corrosion of reinforcing steel, anchor bolts and other buried metallic conduits. Resistivity determinations on the soil indicate very severe potential for metal loss because of electrochemical corrosion processes.

Mitigation of the corrosion of steel can be achieved by using steel pipes coated with epoxy corrosion inhibitors, asphaltic and epoxy coatings, cathodic protection or by encapsulating the portion of the pipe lying above groundwater with a minimum of 3 inches of densely consolidated concrete.

Foundation designs shall provide a minimum concrete cover of three (3) inches around steel reinforcing or embedded components (anchor bolts, etc.) exposed to native soil. If the 3-inch concrete edge distance cannot be achieved, all embedded steel components (anchor bolts, etc.) shall be epoxy coated for corrosion protection (in accordance with ASTM D3963/A934) or a corrosion inhibitor and a permanent waterproofing membrane shall be placed along the exterior face of the exterior footings. Additionally, the concrete should be thoroughly vibrated at footings during placement to decrease the permeability of the concrete.

4.6 Excavations

All site excavations should conform to CalOSHA requirements for Type C soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may be cut nearly vertical for short duration. Sandy soil slopes should be kept moist, but not saturated, to reduce the potential of raveling or sloughing. Excavations deeper than 4 feet will require shoring or slope inclinations in conformance to CAL/OSHA regulations for Type C soil.

Surcharge loads of stockpiled soil or construction materials should be set back from the top of the slope a minimum distance equal to the height of the slope. All permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination.

4.7 Seismic Design

This site is located in the seismically active southern California area and the site structures are subject to strong ground shaking due to potential fault movements along the Laguna Salada, Borrego, Pescadores, Superstition Hills, and Cerro Prieto Faults. Engineered design and earthquake-resistant construction are the common solutions to increase safety and development of seismic areas. Designs should comply with the latest edition of the CBC for Site Class D using the seismic coefficients given in Section 3.4 of this report.

4.8 Pavements

The all-weather access road for the switchyard should consist of a minimum of 12.0 inches of Caltrans Class 2 aggregate base placed over 12 inches of moisture conditioned native clay soil (minimum of 2% above optimum moisture) compacted to a minimum of 90% of the maximum dry density determined by ASTM D1557.

Pavements (if required to connect to Hwy 98) should be designed according to CALTRANS or other acceptable methods. Traffic indices were not provided by the project engineer or public agency: therefore, we have provided structural sections for several traffic indices for comparative evaluation. The public agency or design engineer should decide the appropriate traffic index for the site. Maintenance of proper drainage is necessary to prolong the service life of the pavements.

Based on the current State of California CALTRANS method, an estimated R-value of 5 for the subgrade soil and assumed traffic indices, the following table provides our estimates for asphaltic concrete (AC) pavement sections.

TABLE 11: RECOMMENDED PAVEMENTS SECTIONS

Design Method - CALTRANS 2006

R-Value of Subgrade Soil - 5 (estimated)

Traffic Index (assumed)	Flexible Pavements	
	Asphaltic Concrete Thickness (in.)	Aggregate Base Thickness (in.)
4.0	3.0	6.5
5.0	3.0	9.0
6.0	3.0	14.0
6.5	4.0	14.0
8.0	4.0	18.0
10.0	4.5	26.0
11.0	5.5	28.0

Notes:

1) Asphaltic concrete shall be Caltrans, Type A, ¾ inch maximum, medium grading with PG70-10 asphalt cement, compacted to a minimum of 95% of the Hveem density (CAL 366).
2) Aggregate base shall conform to Caltrans Class 2 (¾ in. maximum), compacted to a minimum of 95% of ASTM D1557 maximum dry density.
3) Place pavements on 12 inches of moisture conditioned (minimum 2% above optimum if clays) native clay soil compacted to a minimum of 90% (95% if sand subgrade) of the maximum dry density determined by ASTM D1557.
4) Typical Street Classifications (Imperial County)

Parking Areas:	TI = 4.0
Cul-de-Sacs:	TI = 5.0
Local Streets:	TI = 6.0
Minor Collectors:	TI = 6.5
Major Collectors:	TI = 8.0
Minor Arterial:	TI = 10.0
Primary Arterial:	TI = 11.0

Section 5
LIMITATIONS AND ADDITIONAL SERVICES

5.1 Limitations

The professional opinions and conclusions within this report are based on current information regarding the proposed approximately 4-mile 230kV power transmission line and Drew switchyard located on the south side of State Hwy 98 at the Westside Main Canal approximately 10 miles west of Calexico, California. The conclusions and professional opinions of this report are invalid if:

- Structural loads change from those stated or the structures are relocated.
- The Additional Services section of this report is not followed.
- This report is used for adjacent or other property.
- Changes of grade or groundwater occur between the issuance of this report and construction other than those anticipated in this report.
- Any other change that materially alters the project from that proposed at the time this report was prepared.

Findings and professional opinions in this report are based on selected points of field exploration, geologic literature, laboratory testing, and our understanding of the proposed project. Our analysis of data and professional opinions presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil conditions can exist between and beyond the exploration points or groundwater elevations may change. If detected, these conditions may require additional studies, consultation, and possible design revisions.

This report contains information that may be useful in the preparation of contract specifications. However, the report is not worded is such a manner that we recommend its use as a construction specification document without proper modification. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

This report was prepared according to the generally accepted *geotechnical engineering standards of practice* that existed in Imperial County at the time the report was prepared. No express or implied warranties are made in connection with our services.

This report should be considered invalid for periods after two years from the report date without a review of the validity of the findings and professional opinions by our firm, because of potential changes in the Geotechnical Engineering Standards of Practice.

The client has responsibility to see that all parties to the project including, designer, contractor, and subcontractor are made aware of this entire report. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

5.2 Additional Services

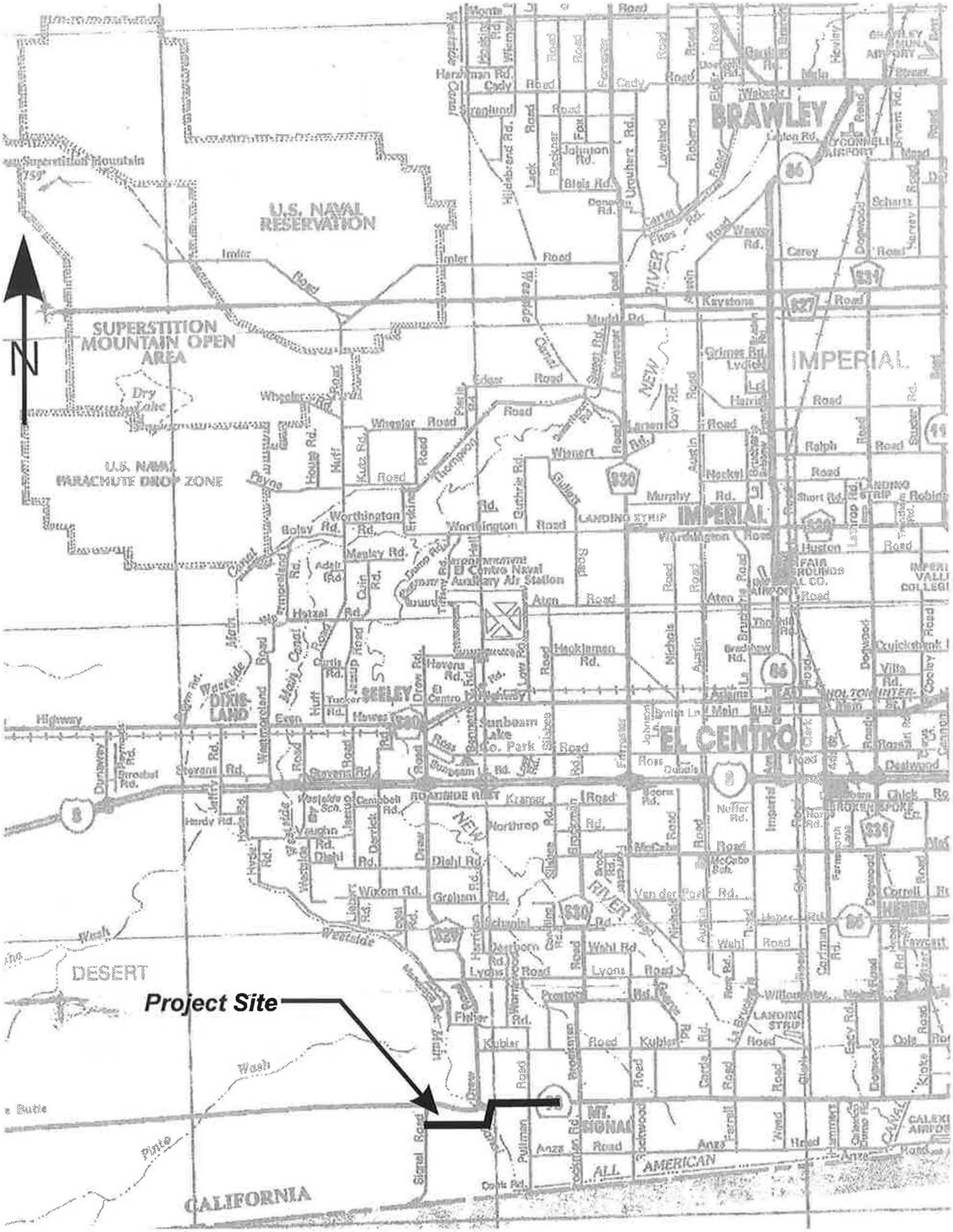
We recommend that a qualified geotechnical consultant be retained to provide the tests and observations services during construction. *The geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

The professional opinions presented in this report are based on the assumption that:

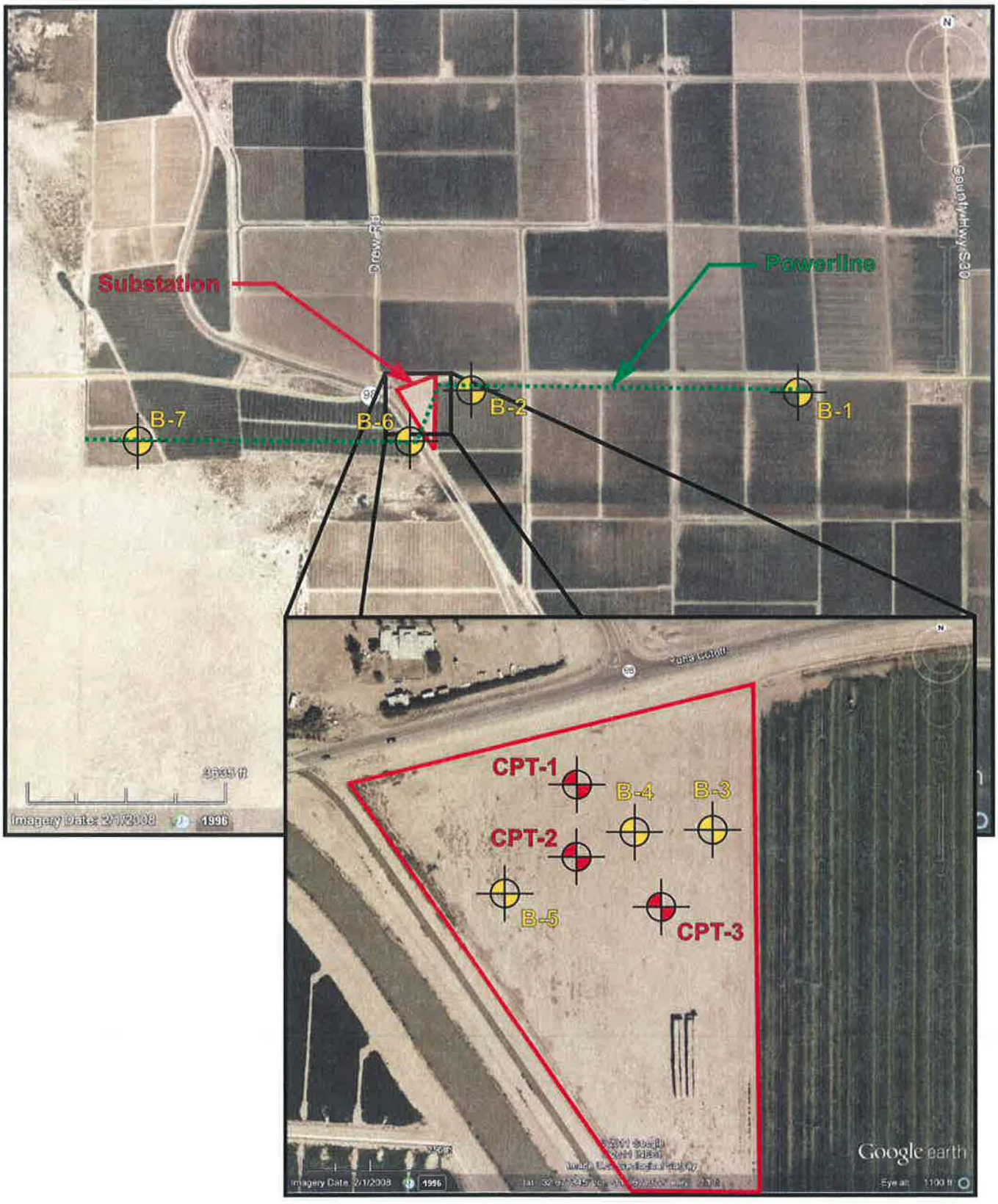
- Consultation during development of design and construction documents to check that the geotechnical professional opinions are appropriate for the proposed project and that the geotechnical professional opinions are properly interpreted and incorporated into the documents.
- Landmark Consultants will have the opportunity to review and comment on the plans and specifications for the project prior to the issuance of such for bidding.
- Continuous observation, inspection, and testing by the geotechnical consultant of record during site clearing, grading, excavation, placement of fills, subgrade preparation, and backfilling of utility trenches.
- Observation of foundation excavations and reinforcing steel before concrete placement.
- Other consultation as necessary during design and construction.

We emphasize our review of the project plans and specifications to check for compatibility with our professional opinions and conclusions. Additional information concerning the scope and cost of these services can be obtained from our office.

APPENDIX A



LANDMARK Geo-Engineers and Geologists **Project No.: LE11210**	**Vicinity Map**	**Plate A-1**



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Project No.: LE11210

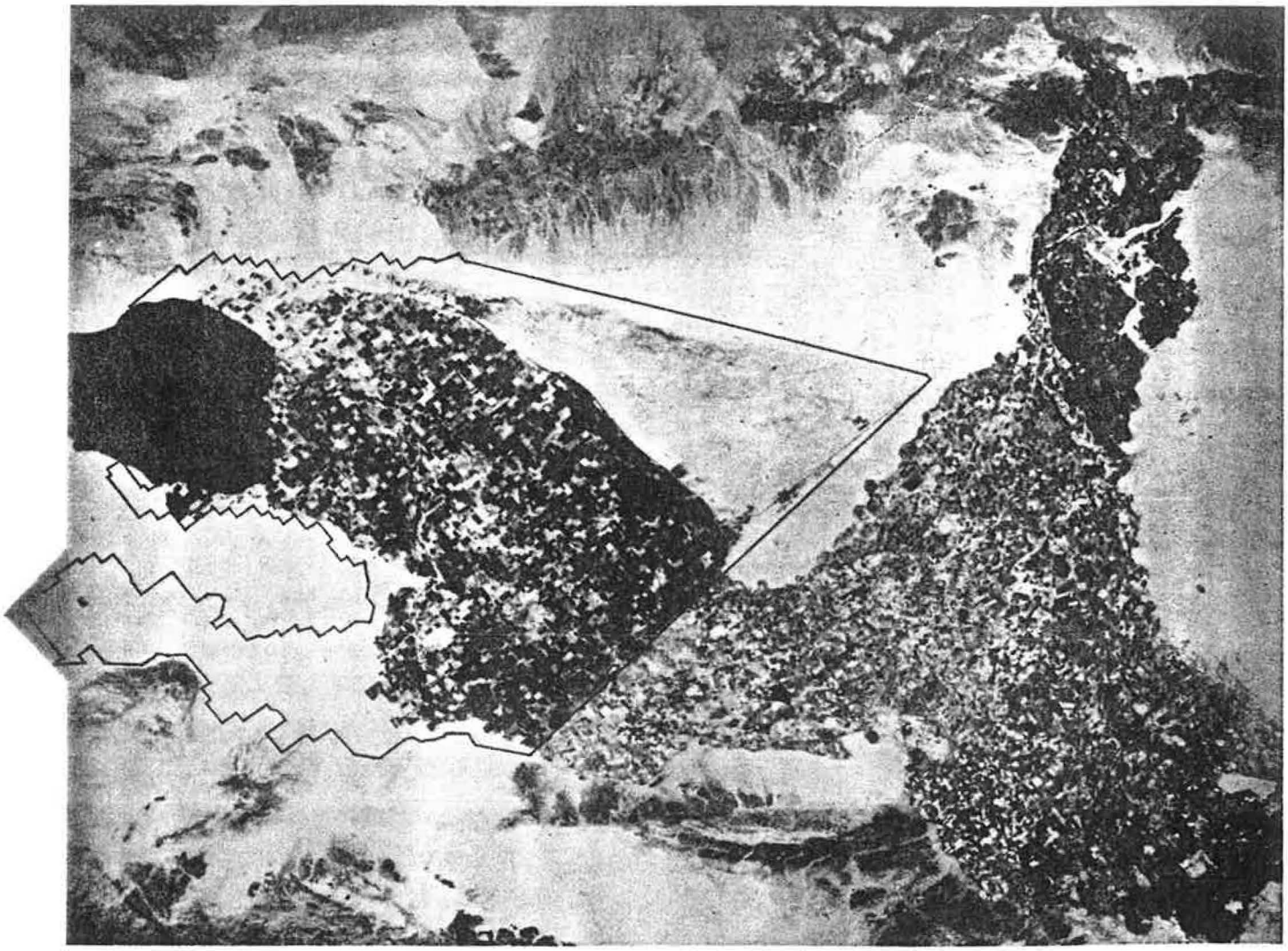
Field Exploration Location Map

Plate
A-2

LANDMARK Geo-Engineers and Geologists Project No.: LE11210	Soil Survey Map	Plate A-3

Soil Survey of

IMPERIAL COUNTY CALIFORNIA IMPERIAL VALLEY AREA



United States Department of Agriculture Soil Conservation Service
in cooperation with
University of California Agricultural Experiment Station
and
Imperial Irrigation District

TABLE 11.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
100----------	0-13	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
Antho	13-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
101*:											
Antho----------	0-8	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	8-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
Superstition------	0-6	Fine sand-------	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
102*. Badland											
103----------	0-10	Gravelly sand---	SP, SP-SM	A-1, A-2	0-5	60-90	50-85	30-55	0-10	---	NP
Carsitas	10-60	Gravelly sand, gravelly coarse sand, sand.	SP, SP-SM	A-1	0-5	60-90	50-85	25-50	0-10	---	NP
104* Fluvaquents											
105----------	0-13	Clay loam-------	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
Glenbar	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
106----------	0-13	Clay loam-------	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
Glenbar	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
107*----------	0-13	Loam----------	ML, CL-ML, CL	A-4	0	100	100	100	70-80	20-30	NP-10
Glenbar	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	75-95	35-45	15-30
108----------	0-14	Loam----------	ML	A-4	0	100	100	85-100	55-95	25-35	NP-10
Holtville	14-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
109----------	0-17	Silty clay------	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
Holtville	17-24	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP
110----------	0-17	Silty clay------	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
Holtville	17-24	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	55-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
111*:											
Holtville	0-10	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	10-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
Imperial	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
112	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
Imperial	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
113	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
Imperial	12-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	100	85-95	50-70	25-45
114	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
Imperial	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
115*:											
Imperial	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
116*:											
Imperial	0-13	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	13-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
117, 118	0-12	Loam	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
Indio	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
119*:											
Indio	0-12	Loam	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
Vint	0-10	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	25-35	---	NP
	10-60	Loamy sand, loamy fine sand.	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
120*	0-12	Loam	ML, CL-ML	A-4	0	100	95-100	75-85	55-65	20-30	NP-10
Laveen	12-60	Loam, very fine sandy loam.	ML, CL-ML	A-4	0	95-100	85-95	70-80	55-65	15-25	NP-10

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

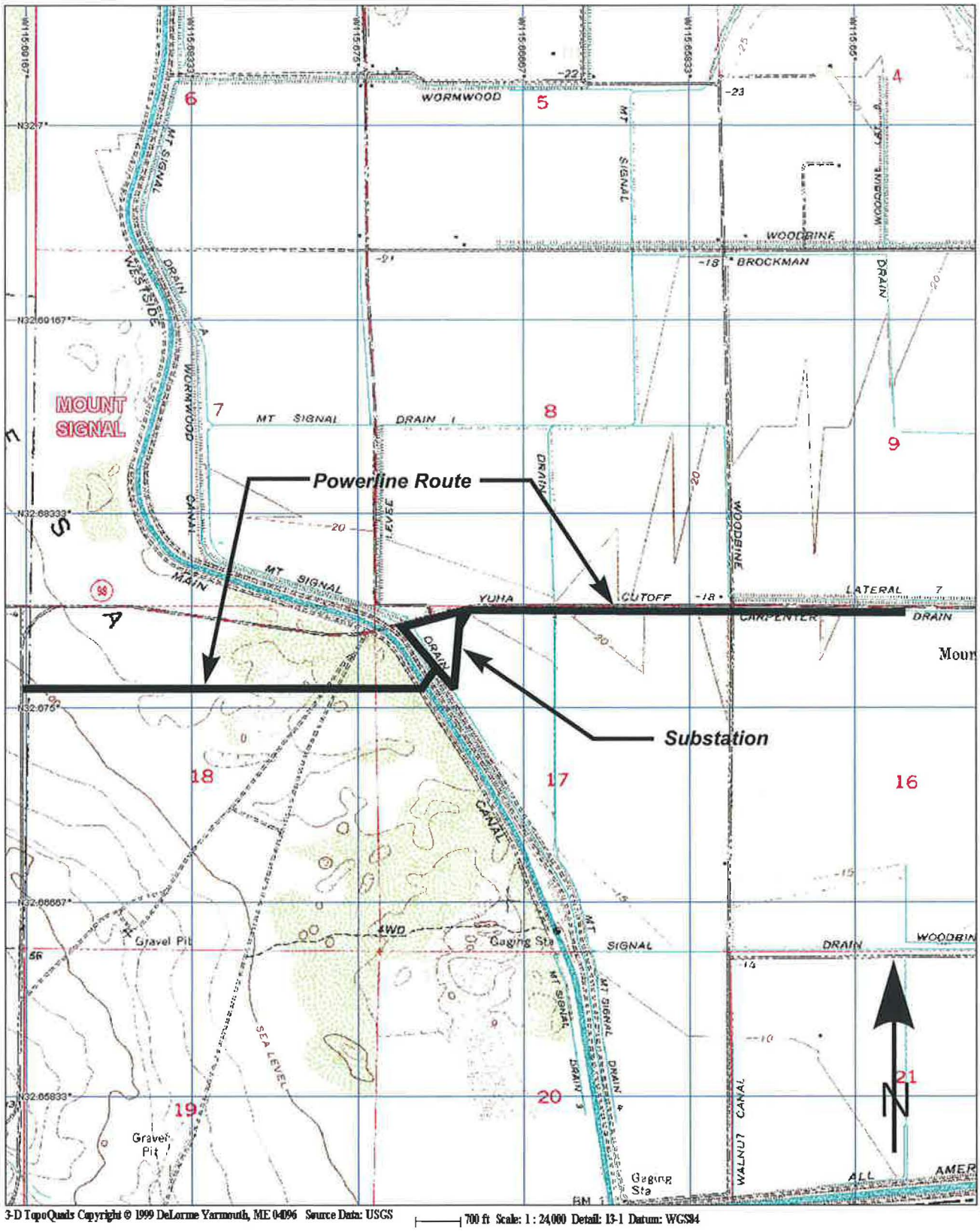
Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
121---------- Meloland	0-12	Fine sand-------	SM, SP-SM	A-2, A-3	0	95-100	90-100	75-100	5-30	---	NP
	12-26	Stratified loamy fine sand to silt loam.	ML	A-4	0	100	100	90-100	50-65	25-35	NP-10
	26-71	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-40
122---------- Meloland	0-12	Very fine sandy loam.	ML	A-4	0	95-100	95-100	95-100	55-85	25-35	NP-10
	12-26	Stratified loamy fine sand to silt loam.	ML	A-4	0	100	100	90-100	50-70	25-35	NP-10
	26-71	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-40
123*:											
Meloland----------	0-12	Loam----------	ML	A-4	0	95-100	95-100	95-100	55-85	25-35	NP-10
	12-26	Stratified loamy fine sand to silt loam.	ML	A-4	0	100	100	90-100	50-70	25-35	NP-10
	26-38	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-40
	38-60	Stratified silt loam to loamy fine sand.	SM, ML	A-4	0	100	100	75-100	35-55	25-35	NP-10
Holtville---------	0-12	Loam----------	ML	A-4	0	100	100	85-100	55-95	25-35	NP-10
	12-24	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-36	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	55-85	25-35	NP-10
	36-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP
124, 125---------- Niland	0-23	Gravelly sand---	SM, SP-SM	A-2, A-3	0	90-100	70-95	50-65	5-25	---	NP
	23-60	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	85-100	80-95	40-65	20-40
126---------- Niland	0-23	Fine sand-------	SM, SP-SM	A-2, A-3	0	90-100	90-100	50-65	5-25	---	NP
	23-60	Silty clay------	CL, CH	A-7	0	100	100	85-100	80-95	40-65	20-40
127---------- Niland	0-23	Loamy fine sand	SM	A-2	0	90-100	90-100	50-65	15-30	---	NP
	23-60	Silty clay------	CL, CH	A-7	0	100	100	85-100	80-95	40-65	20-40
128*:											
Niland----------	0-23	Gravelly sand---	SM, SP-SM	A-2, A-3	0	90-100	70-95	50-65	5-25	---	NP
	23-60	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	85-100	80-100	40-65	20-40
Imperial----------	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
129*: Pits											
130, 131---------- Rositas	0-27	Sand----------	SP-SM	A-3, A-1, A-2	0	100	80-100	40-70	5-15	---	NP
	27-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
132, 133, 134, 135-Rositas	0-9	Fine sand-------	SM	A-3, A-2	0	100	80-100	50-80	10-25	---	NP
	9-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
136----------	0-4	Loamy fine sand	SM	A-1, A-2	0	100	80-100	40-85	10-35	---	NP
Rositas	4-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
137----------	0-12	Silt loam-------	ML	A-4	0	100	100	90-100	70-90	20-30	NP-5
Rositas	12-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
138*:											
Rositas----------	0-4	Loamy fine sand	SM	A-1, A-2	0	100	80-100	40-85	10-35	---	NP
	4-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
Superstition------	0-6	Loamy fine sand	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
139----------	0-6	Loamy fine sand	SM	A-2	0	100	95-100	70-85	15-25	---	NP
Superstition	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
140*:											
Torriorthents											
Rock outcrop											
141*:											
Torriorthents											
Orthids											
142----------	0-10	Loamy very fine sand.	SM, ML	A-4	0	100	100	85-95	40-65	15-25	NP-5
Vint	10-60	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
143----------	0-12	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4	0	100	100	75-85	45-55	15-25	NP-5
Vint	12-60	Loamy sand, loamy fine sand.	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
144*:											
Vint----------	0-10	Very fine sandy loam.	SM, ML	A-4	0	100	100	85-95	40-65	15-25	NP-5
	10-40	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
	40-60	Silty clay------	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
Indio----------	0-12	Very fine sandy loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-40	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	40-72	Silty clay------	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35

* See description of the map unit for composition and behavior characteristics of the map unit.



LANDMARK
Geo-Engineers and Geologists

Project No.: LE11210

Topographic Map

Plate A-4

APPENDIX B

LOG OF BORING No. B-1

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			16	2.0	SILTY CLAY (CL): Reddish brown, moist, stiff to very stiff.	97.9	25.5	
			7	1.5				
			18	2.0		95.4	29.0	c=0.83 tsf
10			6		CLAYEY SILT (ML): Brown, very moist to saturated, loose.		29.1	Passing #200 = 98%
15			34	4.5	SILTY CLAY (CL): Brown, moist, hard.	98.7	25.9	c=2.42 tsf
20			10	3.5	very stiff, some gastropods.			
25			23	4.0				
30			18		SILTY SAND (SM): Brown, saturated, medium dense, fine to medium grained.		17.9	Passing #200 = 15%
35			28					
40			22	3.0	SILTY CLAY (CL): Reddish brown, moist, very stiff to hard.			
45			47		SILT (ML): Brown, saturated, dense, some very fine grained sand.			
50			8		SILTY SAND/SILTY CLAY (SM/CL): Brown, very moist to saturated, loose/stiff, interbedded.			
55					Total Depth = 51.5' Groundwater encountered at approximately 22.5 feet at time of drilling Backfilled with excavated soil			
60								

DATE DRILLED:	10/16/11	TOTAL DEPTH:	51.5 Feet	DEPTH TO WATER:	5 ft
LOGGED BY:	S. Williams	TYPE OF BIT:	Hollow Stem Auger	DIAMETER:	8 in.
SURFACE ELEVATION:	Approximately -12'	HAMMER WT.:	140 lbs.	DROP:	30 in.

PROJECT NO. LE11210

LANDMARK
Geo-Engineers and Geologists

PLATE B-1

LOG OF BORING No. B-2

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
0					SILTY CLAY (CL): Brown, moist, stiff to very stiff.			
			10	3.0				
5			16	1.5		101.5	24.0	
			14		SILTY SAND (SM): Lt. brown, saturated, medium dense, fine grained sand, some thin clay layers.			
10			28	2.5	SILTY CLAY (CL): Brown, moist, very stiff.	95.4	29.5	c=1.10 tsf
15			13	2.0	SILTY SAND/SILTY CLAY (SM/CL): Brown, saturated, medium dense/stiff, interbedded.			
20			3	1.0	CLAY (CH): Brown, moist, stiff to very stiff.	96.1	27.7	c=0.51 tsf
25			15	4.5				
30			6	1.0		97.7	26.2	LL=54% PI=38%
35			14	3.0	4" sand at 36 ft.			
40			12	2.0				
45			23		CLAYEY SAND (SC): Lt. brown, saturated, medium dense, fine grained.		13.7	Passing #200 = 22%
50			34		SILTY SAND (SM): Tan, saturated, dense, fine to medium grained, some fine gravel.			
55					Total Depth = 51.5' Groundwater encountered at approximately 8 feet at time of drilling Backfilled with excavated soil			
60								

DATE DRILLED:	10/16/11	TOTAL DEPTH:	51.5 Feet	DEPTH TO WATER:	8.0 ft
LOGGED BY:	S. Williams	TYPE OF BIT:	Hollow Stem Auger	DIAMETER:	8 in.
SURFACE ELEVATION:	Approximately -12'	HAMMER WT.:	140 lbs.	DROP:	30 in.

PROJECT NO. LE11210

LANDMARK
Geo-Engineers and Geologists

PLATE B-2

LOG OF BORING No. B-3

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
0			5	2.5	CLAY (CH): Reddish brown, moist, very stiff.		30.2	LL=64% PI=44%
5			17	2.5				
			14		SILTY SAND (SM): Lt. brown, saturated, medium dense, fine grained sand, some thin clay layers.		20.9	Passing #200 = 13%
10			14	2.5	CLAY (CH): Reddish brown, moist, very stiff.	106.5	20.2	
15			10	2.5				
20			27	2.5 3.0	thin sandy layers (½" thick)			
25			9		CLAYEY SILT (CL-ML): Brown, very moist to wet, loose to medium dense, some interbedded clay.		28.2	LL=29% PI=8%
30			18					
35			8	4.0 2.0	CLAY (CH): Reddish brown, moist, very stiff to hard, 6" sand at 36 ft..			
40			18		CLAY/SILTY SAND (CH/SM): Reddish brown/brown, moist/saturated, stiff/medium dense, interbedded.			
45								
50								
55					Total Depth = 41.5' Groundwater encountered at approximately 4 feet at time of drilling Backfilled with excavated soil			
60								

DATE DRILLED:	10/3/11	TOTAL DEPTH:	41.5 Feet	DEPTH TO WATER:	4.0 ft
LOGGED BY:	S. Williams	TYPE OF BIT:	Hollow Stem Auger	DIAMETER:	8 in.
SURFACE ELEVATION:	Approximately -12'	HAMMER WT.:	140 lbs.	DROP:	30 in.

PROJECT NO. LE11210

LANDMARK
Geo-Engineers and Geologists

PLATE B-3

LOG OF BORING No. B-4

SHEET 1 OF 1

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			4	2.0	SILTY CLAY (CL): Reddish brown, moist, stiff to very stiff.			
			15	1.5		95.1	28.9	c=0.74 tsf
10			19		SILTY SAND (SM): Lt. brown, saturated, medium dense to dense, fine grained.		18.5	Passing #200 = 13%
			31			111.4	16.4	
15			14	2.5	CLAY (CH): Reddish brown, moist, very stiff, some gastropods.			
20			31	3.0		105.8	20.2	
25			10		CLAYEY SILT (ML): Brown, saturated, medium dense, some gypsum crystals.			
30			28	4.0	SILTY CLAY (CL): Reddish brown, moist, very stiff to hard.			
35			7		SILTY SAND (SM): Lt. brown, saturated, loose, fine grained.		20.8	Passing #200 = 15%
40				1.5	SILTY CLAY (CL): Reddish brown, moist, very stiff to hard.			
			24		SILTY SAND (SM): Lt. brown, saturated, medium dense to dense, fine grained.			
45			48		SAND (SP): Tan, saturated, dense, fine to medium grained, gravel.			
50								
55					Total Depth = 50.0' Groundwater encountered at approximately 4 feet at time of drilling Backfilled with excavated soil			
60								

DATE DRILLED: 10/3/11 | TOTAL DEPTH: 50.0 Feet | DEPTH TO WATER: 4.0 ft

LOGGED BY: S. Williams | TYPE OF BIT: Hollow Stem Auger | DIAMETER: 8 in.

SURFACE ELEVATION: Approximately -12' | HAMMER WT.: 140 lbs. | DROP: 30 in.

PROJECT NO. LE11210

LANDMARK
Geo-Engineers and Geologists

PLATE B-4

LOG OF BORING No. B-5

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			8 11	1.0 1.5	SILTY CLAY (CL): Reddish brown, moist, stiff.	102.3	19.2	LL=49% PI=33%
10			19 5		SILTY SAND (SM): Lt. brown, saturated, medium dense to loose, fine grained, micaceous, some gastropods.	106.1	20.1 21.2	Passing #200 = 7.5%
15			17	2.0	CLAY (CH): Reddish brown, moist, very stiff.			
20			9	2.0 4.0				
25			29	4.5		99.5	26.7	c=1.75 tsf
30					CLAYEY SILT (ML): Brown, saturated, medium dense.			
35			11 27	4.0 2.0 4.0	CLAY (CH): Reddish brown, moist, very stiff to hard.			
40			7		SILTY SAND (SM): Lt. brown, saturated, loose, fine grained.			
45			70		SAND (SP): Tan, saturated, very dense, fine to medium grained, gravelly.			Passing #200 = 5.4%
50			58		SILTY SAND (SM): Lt. brown, saturated, very dense, fine grained.			
55					Total Depth = 51.5' Groundwater encountered at 3.5 feet after 24 hours Backfilled with excavated soil			
60								

DATE DRILLED:	10/3/11	TOTAL DEPTH:	51.5 Feet	DEPTH TO WATER:	3.5 ft
LOGGED BY:	S. Williams	TYPE OF BIT:	Hollow Stem Auger	DIAMETER:	8 in.
SURFACE ELEVATION:	Approximately -12'	HAMMER WT.:	140 lbs.	DROP:	30 in.

PROJECT NO. LE11210

LANDMARK
Geo-Engineers and Geologists

PLATE B-5

LOG OF BORING No. B-6

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			6		SILTY SAND (SM): Tan, moist to saturated, medium dense, fine grained sand.			
			20		½" clay layer at 9' ▼	112.6	15.2	
10			5				22.3	Passing #200 = 14%
			32		dense			
15			15	3.5	SILTY CLAY (CL): Brown, moist, very stiff.			
20			15	0.5	SILTY SAND/SILTY CLAY (SM/CL): Brown, saturated, medium dense/stiff, interbedded.			
25			5	2.0				
30			12		CLAYEY SILT (ML): Brown, saturated, medium dense.			
35			10	3.0	SILTY CLAY (CL): Brown, moist, stiff to very stiff.			
40			24	3.0	some interbedded sand			
45			20		SILTY SAND (SM): Brown, saturated, medium dense to dense, fine to medium grained, some fine gravel.		28.2	Passing #200 = 13%
50			48		golden brown, fine grained			
55					Total Depth = 51.5' Groundwater encountered at approximately 8 feet at time of drilling Backfilled with excavated soil			
60								

DATE DRILLED:	10/16/11	TOTAL DEPTH:	51.5 Feet	DEPTH TO WATER:	6.0 ft
LOGGED BY:	S. Williams	TYPE OF BIT:	Hollow Stem Auger	DIAMETER:	8 in.
SURFACE ELEVATION:	Approximately -12'	HAMMER WT.:	140 lbs.	DROP:	30 in.

PROJECT NO. LE11210

LANDMARK
Geo-Engineers and Geologists

PLATE B-6

LOG OF BORING No. B-7

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			17 15		SILTY SAND (SM): Tan, dry to moist, medium dense, fine to medium grained, micaceous, some clay balls.		5.1	
			43	4.5	CLAY (CH): Brown, moist, hard, fractured.			
10			18		SAND (SP): Tan, damp to moist, dense to very dense, fine to medium grained.			
15			17			89.2	1.9	Passing #200 = 2%
20			37		saturated, trace fine gravel.			
25			92/8"					
30			46		some fine gravel.		20.1	Passing #200 = 7%
35			32					
40			77/11"					
45			50/5"					
50			20		some fine gravel.			
55					Total Depth = 51.5' Groundwater encountered at 18 feet. Backfilled with excavated soil			
60								

DATE DRILLED:	10/16/11	TOTAL DEPTH:	51.5 Feet	DEPTH TO WATER:	18 ft
LOGGED BY:	S. Williams	TYPE OF BIT:	Hollow Stem Auger	DIAMETER:	8 in.
SURFACE ELEVATION:	Approximately -12'	HAMMER WT.:	140 lbs.	DROP:	30 in.

PROJECT NO. LE11210

LANDMARK
Geo-Engineers and Geologists

PLATE B-7

CLIENT: Power Engineers
PROJECT: Centinela Solar Powerline -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight

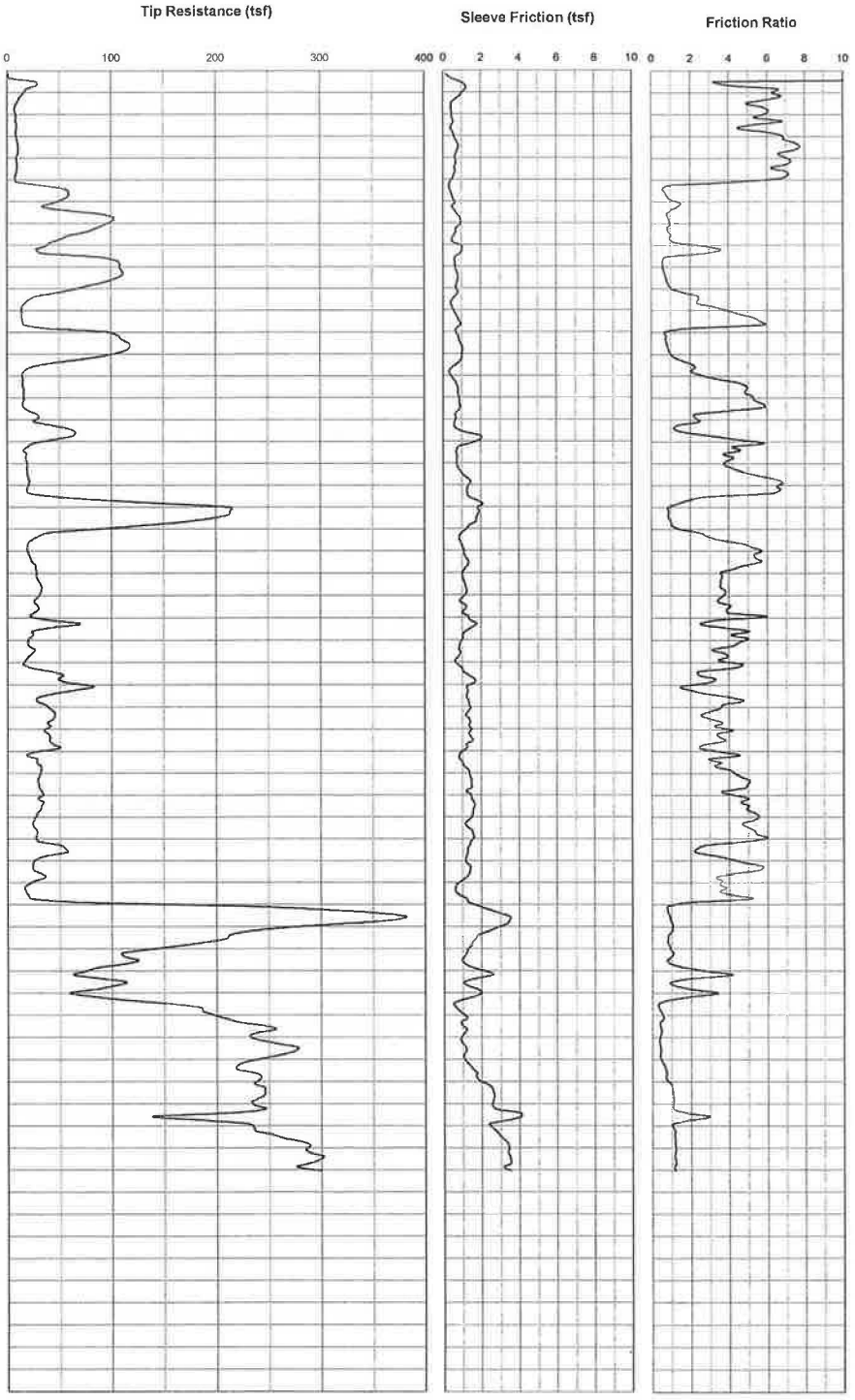
LOCATION: See Site and Boring Location Plan

DATE: 9/27/2011

CONE SOUNDING DATA CPT-1

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	firm
	Clay	" "	stiff
	Clay	" "	stiff
5	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand to Silty Sand	SP/SM	dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	dense
	Sand to Silty Sand	SP/SM	dense
10	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Sand to Silty Sand	SP/SM	dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Clay	CL/CH	stiff
15	Silty Clay to Clay	CL	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
	Sandy Silt to Clayey Silt	ML	dense
20	Sand	SP	dense
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Clay to Clay	CL	very stiff
25	Clayey Silt to Silty Clay	ML/CL	hard
	Silty Clay to Clay	CL	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	hard
	Clayey Silt to Silty Clay	" "	hard
30	Clayey Silt to Silty Clay	" "	hard
	Clayey Silt to Silty Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
	Clay	" "	very stiff
35	Clayey Silt to Silty Clay	ML/CL	hard
	Silty Clay to Clay	CL	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Sand	SP	very dense
	Sand	" "	dense
40	Sand to Silty Sand	SP/SM	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand	SP	dense
	Sand	" "	very dense
	Gravelly Sand to Sand	SW	very dense
45	Sand	SP	very dense
	Sand	" "	very dense
	Sand to Silty Sand	SP/SM	dense
	Sand	SP	very dense
	Sand	" "	very dense
50			
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE11210	LANDMARK Geo-Engineers and Geologists	B-8

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Centinela Solar Powerline -- Calexico, CA **Project No:** LE11210 **Date:** 9/27/2011

CONE SOUNDING: CPT-1

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: 17 Phi (deg.)	Su (tsf)	OCR
0.15	0.5	10.05	13.24	Clay	CL/CH	stiff	125	8		100			0.59	>10
0.30	1.0	21.12	5.62	Clay	CL/CH	very stiff	125	17		85			1.24	>10
0.45	1.5	11.14	5.85	Clay	CL/CH	stiff	125	9		100			0.65	>10
0.60	2.0	7.46	5.90	Clay	CL/CH	firm	125	6		100			0.43	>10
0.75	2.5	8.51	5.79	Clay	CL/CH	firm	125	7		100			0.49	>10
0.93	3.0	8.41	5.75	Clay	CL/CH	firm	125	7		100			0.48	>10
1.08	3.5	9.87	7.36	Clay	CL/CH	stiff	125	8		100			0.57	>10
1.23	4.0	9.92	6.99	Clay	CL/CH	stiff	125	8		100			0.57	>10
1.38	4.5	9.50	6.84	Clay	CL/CH	stiff	125	8		100			0.54	>10
1.53	5.0	8.38	6.94	Clay	CL/CH	firm	125	7		100			0.48	>10
1.68	5.5	39.74	1.63	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	67.6	40	61	37		
1.83	6.0	51.26	1.11	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	83.6	25	67	37		
1.98	6.5	60.79	1.07	Silty Sand to Sandy Silt	SM/ML	dense	115	14	95.3	25	71	38		
2.13	7.0	98.48	0.93	Sand to Silty Sand	SP/SM	dense	115	18	149.0	15	84	40		
2.28	7.5	73.30	0.92	Sand to Silty Sand	SP/SM	dense	115	13	107.2	20	75	38		
2.45	8.0	43.55	1.63	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	61.7	35	58	36		
2.60	8.5	49.52	2.40	Sandy Silt to Clayey Silt	ML	medium dense	115	14	69.2	40	62	37		
2.75	9.0	106.82	0.59	Sand	SP	dense	110	16	147.4	10	84	40		
2.90	9.5	108.37	0.69	Sand	SP	dense	110	17	147.8	10	84	40		
3.05	10.0	79.13	0.92	Sand to Silty Sand	SP/SM	dense	115	14	106.6	20	74	38		
3.20	10.5	32.23	2.15	Sandy Silt to Clayey Silt	ML	medium dense	115	9	42.9	50	47	35		
3.35	11.0	15.01	3.18	Silty Clay to Clay	CL	stiff	125	9		85			0.85	>10
3.50	11.5	14.44	5.15	Clay	CL/CH	stiff	125	12		100			0.82	>10
3.65	12.0	50.30	2.83	Sandy Silt to Clayey Silt	ML	medium dense	115	14	64.3	50	59	36		
3.80	12.5	110.42	0.76	Sand to Silty Sand	SP/SM	dense	115	20	139.6	15	82	40		
3.95	13.0	111.79	0.90	Sand to Silty Sand	SP/SM	dense	115	20	139.8	15	82	40		
4.13	13.5	60.83	1.60	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	75.2	35	64	37		
4.28	14.0	17.35	2.27	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		75			0.98	>10
4.43	14.5	14.94	4.18	Clay	CL/CH	stiff	125	12		100			0.84	9.79
4.58	15.0	15.85	5.00	Clay	CL/CH	stiff	125	13		100			0.89	>10
4.73	15.5	15.48	5.65	Clay	CL/CH	stiff	125	12		100			0.87	9.59
4.88	16.0	26.19	2.71	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		70			1.50	>10
5.03	16.5	55.59	1.42	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	64.3	35	59	36		
5.18	17.0	44.41	4.48	Silty Clay to Clay	CL	hard	125	25		70			2.57	>10
5.33	17.5	17.95	4.17	Silty Clay to Clay	CL	very stiff	125	10		100			1.01	>10
5.48	18.0	18.41	3.97	Silty Clay to Clay	CL	very stiff	125	11		95			1.04	>10
5.65	18.5	19.16	4.81	Clay	CL/CH	very stiff	125	15		100			1.08	>10
5.80	19.0	20.56	6.58	Clay	CL/CH	very stiff	125	16		100			1.16	>10
5.95	19.5	28.96	5.22	Clay	CL/CH	very stiff	125	23		90			1.66	>10
6.10	20.0	157.03	1.33	Sand to Silty Sand	SP/SM	dense	115	29	169.2	20	88	40		
6.25	20.5	207.04	0.88	Sand	SP	very dense	110	32	221.4	10	96	41		
6.40	21.0	127.86	1.18	Sand to Silty Sand	SP/SM	dense	115	23	135.7	20	82	39		
6.55	21.5	30.79	2.97	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		75			1.76	>10
6.70	22.0	19.27	5.20	Clay	CL/CH	very stiff	125	15		100			1.08	9.00
6.85	22.5	21.85	5.46	Clay	CL/CH	very stiff	125	17		100			1.23	>10
7.00	23.0	27.16	4.19	Silty Clay to Clay	CL	very stiff	125	16		90			1.54	>10
7.18	23.5	29.25	3.60	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		85			1.67	>10
7.33	24.0	31.96	3.71	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		85			1.83	>10
7.48	24.5	27.36	3.68	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		90			1.55	>10
7.63	25.0	25.52	4.60	Silty Clay to Clay	CL	very stiff	125	15		100			1.44	>10
7.78	25.5	50.52	3.17	Sandy Silt to Clayey Silt	ML	medium dense	115	14	49.8	65	52	35		
7.93	26.0	22.92	4.71	Clay	CL/CH	very stiff	125	18		100			1.29	>10
8.08	26.5	22.44	3.90	Silty Clay to Clay	CL	very stiff	125	13		100			1.26	>10
8.23	27.0	17.51	4.03	Silty Clay to Clay	CL	stiff	125	10		100			0.97	7.56
8.38	27.5	39.78	3.01	Sandy Silt to Clayey Silt	ML	medium dense	115	11	38.1	75	44	34		
8.53	28.0	62.65	2.56	Sandy Silt to Clayey Silt	ML	medium dense	115	18	59.6	55	57	36		
8.68	28.5	46.26	2.95	Sandy Silt to Clayey Silt	ML	medium dense	115	13	43.7	70	48	35		
8.85	29.0	34.60	4.00	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		85			1.97	>10
9.00	29.5	44.51	2.84	Sandy Silt to Clayey Silt	ML	medium dense	115	13	41.5	70	47	35		
9.15	30.0	37.92	3.70	Clayey Silt to Silty Clay	ML/CL	hard	120	15		85			2.17	>10
9.30	30.5	39.93	3.56	Clayey Silt to Silty Clay	ML/CL	hard	120	16		80			2.28	>10
9.45	31.0	40.54	2.90	Sandy Silt to Clayey Silt	ML	medium dense	115	12	37.1	75	43	34		
9.60	31.5	24.64	3.68	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.38	>10
9.75	32.0	31.88	3.84	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		90			1.81	>10
9.90	32.5	29.54	4.88	Clay	CL/CH	very stiff	125	24		100			1.67	>10
10.05	33.0	32.39	4.24	Silty Clay to Clay	CL	very stiff	125	19		95			1.84	>10
10.20	33.5	32.04	4.87	Clay	CL/CH	very stiff	125	26		100			1.81	>10
10.38	34.0	29.43	5.25	Clay	CL/CH	very stiff	125	24		100			1.66	>10
10.53	34.5	24.82	4.98	Clay	CL/CH	very stiff	125	20		100			1.39	7.41
10.68	35.0	27.73	5.57	Clay	CL/CH	very stiff	125	22		100			1.56	9.00
10.83	35.5	44.95	3.31	Clayey Silt to Silty Clay	ML/CL	hard	120	18		80			2.57	>10
10.98	36.0	40.54	3.22	Clayey Silt to Silty Clay	ML/CL	hard	120	16		80			2.31	>10
11.13	36.5	26.56	5.09	Clay	CL/CH	very stiff	125	21		100			1.49	7.70
11.28	37.0	27.42	3.48	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.54	>10
11.43	37.5	17.76	3.86	Silty Clay to Clay	CL	stiff	125	10		100			0.97	5.00
11.58	38.0	106.14	2.57	Silty Sand to Sandy Silt	SM/ML	medium dense	115	24	89.2	50	69	38		
11.73	38.5	346.16	0.85	Sand	SP	very dense	110	53	289.5	10	104	43		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Centinela Solar Powerline -- Calexico, CA **Project No:** LE11210 **Date:** 9/27/2011

CONE SOUNDING: CPT-1

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	314.49	1.02	Sand	SP	very dense	110	48	261.9	15	101	42		
12.05	39.5	217.38	0.89	Sand	SP	dense	110	33	180.2	15	90	41		
12.20	40.0	161.57	0.88	Sand	SP	dense	110	25	133.4	20	81	39		
12.35	40.5	115.29	0.94	Sand to Silty Sand	SP/SM	dense	115	21	94.8	30	71	38		
12.50	41.0	90.27	1.89	Silty Sand to Sandy Silt	SM/ML	medium dense	115	20	73.8	45	64	37		
12.65	41.5	88.63	2.32	Silty Sand to Sandy Silt	SM/ML	medium dense	115	20	72.2	50	63	37		
12.80	42.0	80.72	2.26	Silty Sand to Sandy Silt	SM/ML	medium dense	115	18	65.4	55	60	36		
12.95	42.5	118.80	0.98	Sand to Silty Sand	SP/SM	dense	115	22	95.9	30	71	38		
13.10	43.0	189.37	0.43	Sand	SP	dense	110	29	152.1	10	85	40		
13.25	43.5	224.94	0.46	Sand	SP	dense	110	35	180.0	10	90	41		
13.40	44.0	241.65	0.44	Gravelly Sand to Sand	SW	very dense	115	32	192.5	10	92	41		
13.58	44.5	259.38	0.38	Gravelly Sand to Sand	SW	very dense	115	35	205.8	5	94	41		
13.73	45.0	259.60	0.42	Gravelly Sand to Sand	SW	very dense	115	35	205.0	10	94	41		
13.88	45.5	222.03	0.61	Sand	SP	dense	110	34	174.7	15	89	40		
14.03	46.0	239.69	0.73	Sand	SP	very dense	110	37	187.8	15	91	41		
14.18	46.5	242.25	1.01	Sand	SP	very dense	110	37	189.1	20	91	41		
14.33	47.0	238.88	1.09	Sand	SP	very dense	110	37	185.7	20	91	41		
14.48	47.5	199.53	1.99	Sand to Silty Sand	SP/SM	dense	115	36	154.5	35	85	40		
14.63	48.0	216.96	1.31	Sand	SP	dense	110	33	167.4	25	88	40		
14.78	48.5	251.16	1.16	Sand	SP	very dense	110	39	193.0	20	92	41		
14.93	49.0	285.38	1.18	Sand	SP	very dense	110	44	218.5	20	96	41		
15.10	49.5	295.81	1.17	Sand	SP	very dense	110	46	225.7	20	97	42		
15.25	50.0	288.19	1.18	Sand	SP	very dense	110	44	219.1	20	96	41		

CLIENT: Power Engineers
PROJECT: Centinela Solar Powerline -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight

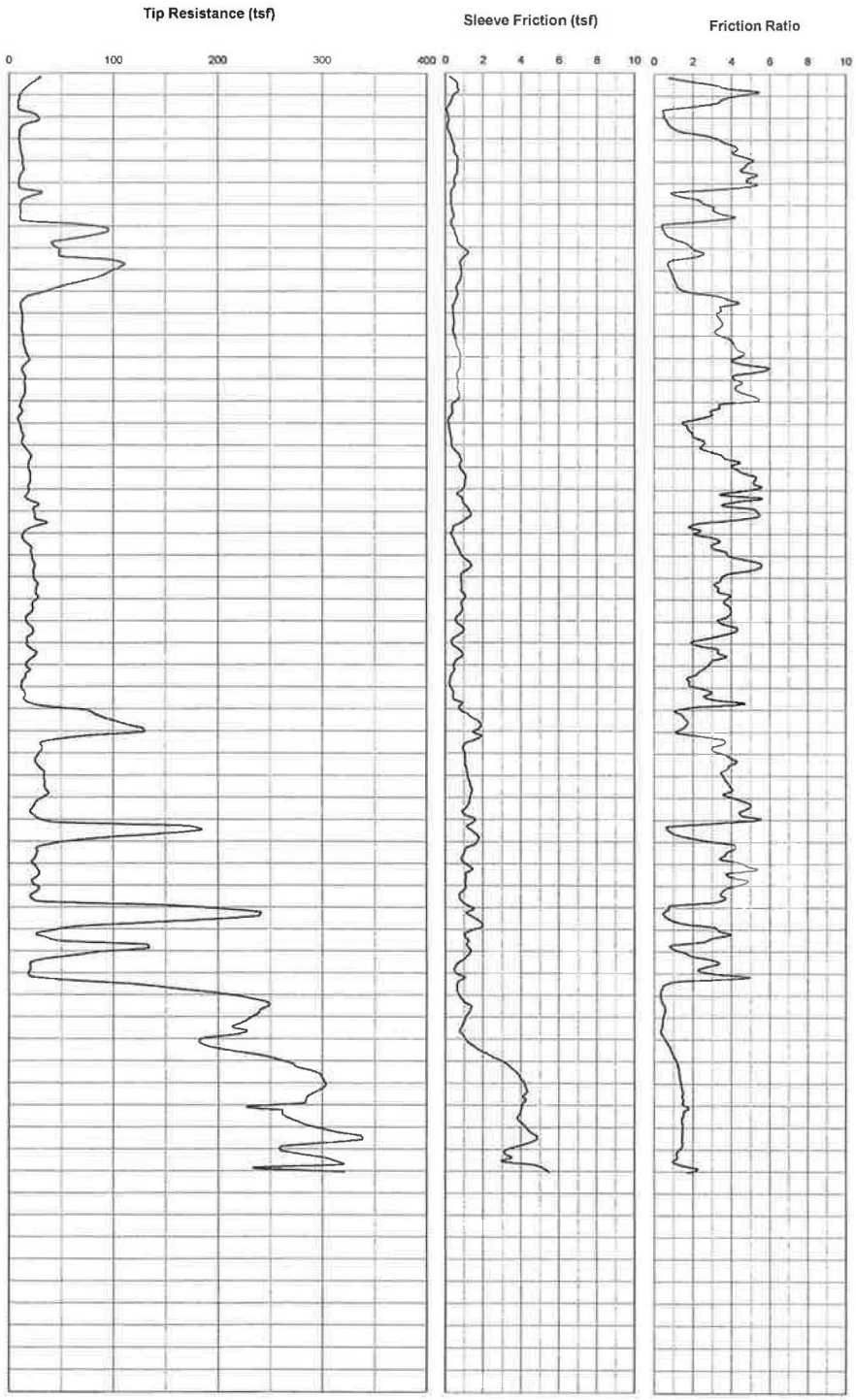
LOCATION: See Site and Boring Location Plan

DATE: 9/27/2011

CONE SOUNDING DATA CPT-2

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Clay	CL/CH	stiff
5	Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand to Silty Sand	SP/SM	dense
10	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
15	Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
20	Clay	" "	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clay	CL/CH	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
25	Silty Clay to Clay	CL	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	very stiff
30	Sand to Silty Sand	SP/SM	dense
	Clayey Silt to Silty Clay	ML/CL	hard
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clay	CL/CH	very stiff
35	Sand to Silty Sand	SP/SM	dense
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Sand to Silty Sand	SP/SM	dense
40	Silty Sand to Sandy Silt	SM/ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Sand to Silty Sand	SP/SM	dense
	Sand	SP	very dense
	Sand	" "	dense
45	Sand	" "	dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
50	Sand	" "	very dense
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE11210	LANDMARK Geo-Engineers and Geologists	B-9

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Centinela Solar Powerline -- Calexico, CA **Project No:** LE11210 **Date:** 9/27/2011

CONE SOUNDING: CPT-2

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: 17 Phi (deg.)	Su (tsf)	OCR
0.15	0.5	25.43	1.92	Sandy Silt to Clayey Silt	ML	very dense	115	7	48.1	50	94	41		
0.30	1.0	13.16	4.49	Clay	CL/CH	stiff	125	11		95			0.77	>10
0.45	1.5	9.22	2.93	Silty Clay to Clay	CL	stiff	125	5		95			0.54	>10
0.60	2.0	19.73	0.49	Silty Sand to Sandy Silt	SM/ML	medium dense	115	4	37.3	35	57	36		
0.75	2.5	18.97	0.79	Sandy Silt to Clayey Silt	ML	medium dense	115	5	35.9	45	52	35		
0.93	3.0	10.01	2.41	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.58	>10
1.08	3.5	10.65	4.02	Clay	CL/CH	stiff	125	9		100			0.61	>10
1.23	4.0	12.45	4.60	Clay	CL/CH	stiff	125	10		100			0.72	>10
1.38	4.5	13.52	4.65	Clay	CL/CH	stiff	125	11		95			0.78	>10
1.53	5.0	10.36	5.01	Clay	CL/CH	stiff	125	8		100			0.59	>10
1.68	5.5	18.69	2.77	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		70			1.08	>10
1.83	6.0	12.09	2.61	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.69	>10
1.98	6.5	11.24	3.56	Silty Clay to Clay	CL	stiff	125	6		95			0.64	>10
2.13	7.0	57.47	1.14	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	87.3	25	68	38		
2.28	7.5	79.49	0.73	Sand to Silty Sand	SP/SM	dense	115	14	116.8	15	77	39		
2.45	8.0	43.98	1.81	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	62.6	40	59	36		
2.60	8.5	64.29	1.86	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	90.2	30	69	38		
2.75	9.0	105.23	0.77	Sand to Silty Sand	SP/SM	dense	115	19	145.7	10	84	40		
2.90	9.5	81.75	1.00	Sand to Silty Sand	SP/SM	dense	115	15	111.7	20	76	39		
3.05	10.0	43.79	1.46	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	59.1	35	57	36		
3.20	10.5	15.40	3.83	Silty Clay to Clay	CL	stiff	125	9		90			0.87	>10
3.35	11.0	11.89	3.37	Silty Clay to Clay	CL	stiff	125	7		95			0.67	>10
3.50	11.5	12.83	3.44	Silty Clay to Clay	CL	stiff	125	7		95			0.72	>10
3.65	12.0	12.92	3.28	Silty Clay to Clay	CL	stiff	125	7		95			0.73	>10
3.80	12.5	14.00	4.05	Clay	CL/CH	stiff	125	11		100			0.79	>10
3.95	13.0	16.81	4.46	Clay	CL/CH	stiff	125	13		95			0.95	>10
4.13	13.5	16.43	4.88	Clay	CL/CH	stiff	125	13		100			0.93	>10
4.28	14.0	14.31	4.55	Clay	CL/CH	stiff	125	11		100			0.80	9.00
4.43	14.5	15.09	4.35	Clay	CL/CH	stiff	125	12		100			0.85	9.59
4.58	15.0	13.99	5.10	Clay	CL/CH	stiff	125	11		100			0.78	7.85
4.73	15.5	11.52	3.22	Silty Clay to Clay	CL	stiff	125	7		100			0.64	7.13
4.88	16.0	10.03	2.10	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.55	7.41
5.03	16.5	12.59	1.90	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		90			0.70	>10
5.18	17.0	13.33	2.48	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		95			0.74	>10
5.33	17.5	19.60	3.32	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		90			1.11	>10
5.48	18.0	18.76	4.22	Silty Clay to Clay	CL	very stiff	125	11		100			1.06	>10
5.65	18.5	20.26	5.02	Clay	CL/CH	very stiff	125	16		100			1.15	>10
5.80	19.0	19.03	5.08	Clay	CL/CH	very stiff	125	15		100			1.07	>10
5.95	19.5	18.32	4.41	Clay	CL/CH	very stiff	125	15		100			1.03	9.39
6.10	20.0	25.32	4.67	Clay	CL/CH	very stiff	125	20		95			1.44	>10
6.25	20.5	28.89	4.00	Silty Clay to Clay	CL	very stiff	125	17		85			1.65	>10
6.40	21.0	18.70	2.08	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		85			1.05	>10
6.55	21.5	14.92	3.13	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.83	>10
6.70	22.0	21.28	3.53	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		95			1.20	>10
6.85	22.5	23.44	5.20	Clay	CL/CH	very stiff	125	19		100			1.33	>10
7.00	23.0	23.42	4.14	Silty Clay to Clay	CL	very stiff	125	13		95			1.32	>10
7.18	23.5	26.03	3.27	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		85			1.48	>10
7.33	24.0	26.50	3.66	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		90			1.50	>10
7.48	24.5	22.91	3.80	Silty Clay to Clay	CL	very stiff	125	13		100			1.29	>10
7.63	25.0	18.31	3.67	Silty Clay to Clay	CL	very stiff	125	10		100			1.02	8.85
7.78	25.5	20.68	4.02	Silty Clay to Clay	CL	very stiff	125	12		100			1.16	>10
7.93	26.0	19.06	2.72	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		95			1.06	>10
8.08	26.5	22.17	3.15	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		95			1.24	>10
8.23	27.0	17.92	2.86	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.99	>10
8.38	27.5	17.61	2.07	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		95			0.97	>10
8.53	28.0	12.26	2.07	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.66	5.21
8.68	28.5	14.81	2.89	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.81	7.00
8.85	29.0	42.85	2.62	Sandy Silt to Clayey Silt	ML	medium dense	115	12	39.8	70	45	34		
9.00	29.5	91.05	1.56	Silty Sand to Sandy Silt	SM/ML	medium dense	115	20	84.2	35	67	37		
9.15	30.0	123.59	1.40	Sand to Silty Sand	SP/SM	dense	115	22	113.6	30	76	39		
9.30	30.5	51.30	3.23	Sandy Silt to Clayey Silt	ML	medium dense	115	15	46.9	70	50	35		
9.45	31.0	30.50	3.24	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		90			1.73	>10
9.60	31.5	25.87	4.04	Silty Clay to Clay	CL	very stiff	125	15		100			1.45	>10
9.75	32.0	32.21	3.60	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		90			1.83	>10
9.90	32.5	33.86	3.80	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		90			1.92	>10
10.05	33.0	35.20	3.90	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		90			2.00	>10
10.20	33.5	24.78	4.83	Clay	CL/CH	very stiff	125	20		100			1.39	7.56
10.38	34.0	24.34	4.82	Clay	CL/CH	very stiff	125	19		100			1.36	7.13
10.53	34.5	134.09	1.51	Sand to Silty Sand	SP/SM	dense	115	24	116.6	30	77	39		
10.68	35.0	105.17	1.85	Silty Sand to Sandy Silt	SM/ML	medium dense	115	23	91.0	40	70	38		
10.83	35.5	30.68	4.04	Silty Clay to Clay	CL	very stiff	125	18		100			1.73	>10
10.98	36.0	24.13	3.83	Silty Clay to Clay	CL	very stiff	125	14		100			1.34	8.70
11.13	36.5	27.22	4.47	Silty Clay to Clay	CL	very stiff	125	16		100			1.52	>10
11.28	37.0	24.58	4.38	Silty Clay to Clay	CL	very stiff	125	14		100			1.37	8.70
11.43	37.5	23.23	3.56	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.29	>10
11.58	38.0	126.93	1.53	Sand to Silty Sand	SP/SM	dense	115	23	106.1	35	74	38		
11.73	38.5	222.77	0.64	Sand	SP	very dense	110	34	185.3	15	91	41		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Centinela Solar Powerline -- Calexico, CA **Project No:** LE11210 **Date:** 9/27/2011

CONE SOUNDING: CPT-2

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	75.90	2.66	Sandy Silt to Clayey Silt	ML	medium dense	115	22	62.8	60	59	36		
12.05	39.5	37.11	3.15	Clayey Silt to Silty Clay	ML/CL	hard	120	15		90			2.10	>10
12.20	40.0	117.67	1.11	Sand to Silty Sand	SP/SM	dense	115	21	96.5	30	71	38		
12.35	40.5	38.47	2.75	Sandy Silt to Clayey Silt	ML	loose	115	11	31.4	85	38	33		
12.50	41.0	19.86	2.73	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.08	7.13
12.65	41.5	68.00	2.21	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	55.0	60	55	36		
12.80	42.0	183.79	0.36	Sand	SP	dense	110	28	147.9	10	84	40		
12.95	42.5	242.57	0.44	Gravelly Sand to Sand	SW	very dense	115	32	194.4	10	92	41		
13.10	43.0	237.45	0.51	Sand	SP	very dense	110	37	189.5	10	91	41		
13.25	43.5	220.52	0.42	Sand	SP	dense	110	34	175.3	10	89	40		
13.40	44.0	209.86	0.44	Sand	SP	dense	110	32	166.1	10	87	40		
13.58	44.5	190.89	0.76	Sand	SP	dense	110	29	150.5	20	85	40		
13.73	45.0	243.82	1.03	Sand	SP	very dense	110	38	191.5	20	92	41		
13.88	45.5	278.82	1.24	Sand	SP	very dense	110	43	218.2	20	96	41		
14.03	46.0	299.88	1.33	Sand	SP	very dense	110	46	233.7	20	98	42		
14.18	46.5	298.13	1.43	Sand	SP	very dense	110	46	231.5	20	97	42		
14.33	47.0	269.94	1.54	Sand to Silty Sand	SP/SM	very dense	115	49	208.8	25	94	41		
14.48	47.5	263.08	1.49	Sand to Silty Sand	SP/SM	very dense	115	48	202.6	25	93	41		
14.63	48.0	286.70	1.44	Sand	SP	very dense	110	44	220.0	20	96	41		
14.78	48.5	329.61	1.43	Sand	SP	very dense	110	51	251.9	20	100	42		
14.93	49.0	273.24	1.36	Sand	SP	very dense	110	42	208.1	20	94	41		
15.10	49.5	296.39	1.09	Sand	SP	very dense	110	46	224.9	20	96	41		
15.25	50.0	291.20	1.80	Sand to Silty Sand	SP/SM	very dense	115	53	220.1	25	96	41		

CLIENT: Power Engineers
PROJECT: Centinela Solar Powerline -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight

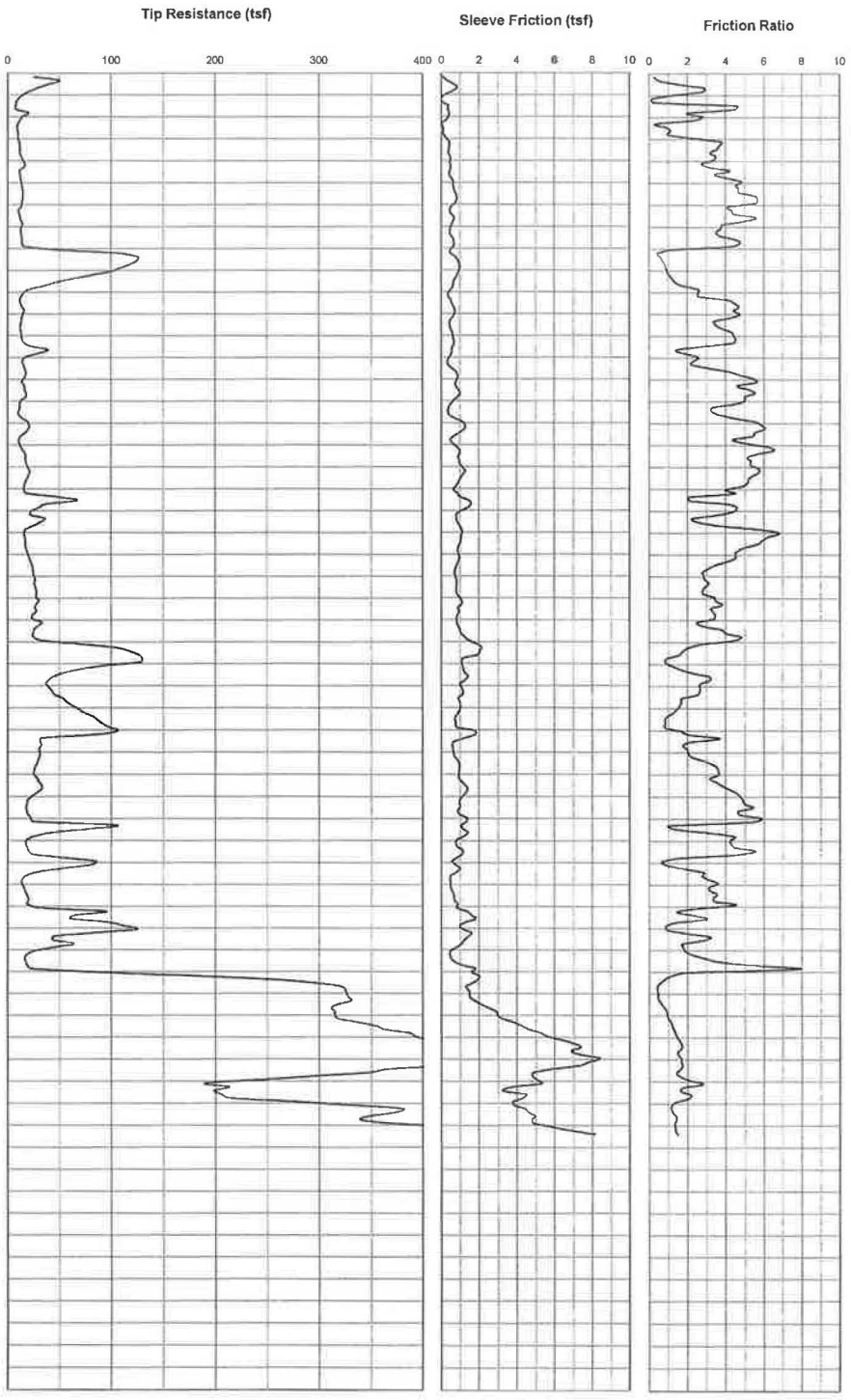
LOCATION: See Site and Boring Location Plan

DATE: 9/27/2011

CONE SOUNDING DATA CPT-3

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sandy Silt to Clayey Silt	ML	dense
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
5	Clay	CL/CH	stiff
	Clay	" "	stiff
	Silty Clay to Clay	CL	very stiff
	Sand	SP	dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
10	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Clay to Clay	CL	stiff
	Clay	CL/CH	stiff
15	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	very stiff
	Clayey Silt to Silty Clay	ML/CL	hard
20	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
25	Clayey Silt to Silty Clay	" "	very stiff
	Sand to Silty Sand	SP/SM	dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand to Silty Sand	SP/SM	medium dense
30	Sandy Silt to Clayey Silt	ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clay	CL/CH	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
35	Clayey Silt to Silty Clay	ML/CL	hard
	Sandy Silt to Clayey Silt	ML	loose
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sandy Silt to Clayey Silt	ML	medium dense
40	Silty Clay to Clay	CL	very stiff
	Gravelly Sand to Sand	SW	very dense
	Gravelly Sand to Sand	" "	very dense
	Sand	SP	very dense
	Sand	" "	very dense
45	Sand to Silty Sand	SP/SM	very dense
	Sand to Silty Sand	" "	dense
	Sand	SP	very dense
50			
55			

END OF SOUNDING AT 48 ft.



Project No.		PLATE
LE11210	LANDMARK Geo-Engineers and Geologists	B-10

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Centinela Solar Powerline -- Calexico, CA **Project No:** LE11210 **Date:** 9/27/2011

CONE SOUNDING: CPT-3

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: 17 Phi (deg.)	Su (tsf)	OCR
0.15	0.5	38.70	0.79	Silty Sand to Sandy Silt	SM/ML	very dense	115	9	73.2	25	106	43		
0.30	1.0	22.01	2.30	Sandy Silt to Clayey Silt	ML	dense	115	6	41.6	60	73	38		
0.45	1.5	9.17	1.65	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		80			0.53	>10
0.60	2.0	14.21	3.08	Silty Clay to Clay	CL	stiff	125	8		80			0.83	>10
0.75	2.5	10.37	1.18	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		70			0.60	>10
0.93	3.0	9.83	1.48	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		75			0.57	>10
1.08	3.5	11.51	3.66	Silty Clay to Clay	CL	stiff	125	7		95			0.67	>10
1.23	4.0	13.09	3.34	Silty Clay to Clay	CL	stiff	125	7		85			0.76	>10
1.38	4.5	14.67	3.35	Silty Clay to Clay	CL	stiff	125	8		80			0.85	>10
1.53	5.0	12.52	4.11	Clay	CL/CH	stiff	125	10		95			0.72	>10
1.68	5.5	14.42	4.85	Clay	CL/CH	stiff	125	12		95			0.83	>10
1.83	6.0	13.79	5.11	Clay	CL/CH	stiff	125	11		100			0.79	>10
1.98	6.5	11.18	4.77	Clay	CL/CH	stiff	125	9		100			0.64	>10
2.13	7.0	13.49	4.18	Clay	CL/CH	stiff	125	11		95			0.77	>10
2.28	7.5	13.39	3.86	Clay	CL/CH	stiff	125	11		90			0.76	>10
2.45	8.0	25.48	3.40	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		65			1.47	>10
2.60	8.5	119.40	0.57	Sand	SP	dense	110	18	166.1	5	87	40		
2.75	9.0	109.33	0.87	Sand to Silty Sand	SP/SM	dense	115	20	150.2	15	84	40		
2.90	9.5	65.06	1.19	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	88.2	25	69	38		
3.05	10.0	24.88	2.28	Sandy Silt to Clayey Silt	ML	medium dense	115	7	33.3	60	40	34		
3.20	10.5	12.52	3.72	Silty Clay to Clay	CL	stiff	125	7		95			0.70	>10
3.35	11.0	14.98	4.61	Clay	CL/CH	stiff	125	12		100			0.85	>10
3.50	11.5	13.36	3.70	Silty Clay to Clay	CL	stiff	125	8		95			0.75	>10
3.65	12.0	12.99	4.17	Clay	CL/CH	stiff	125	10		100			0.73	8.85
3.80	12.5	17.48	3.91	Silty Clay to Clay	CL	stiff	125	10		90			0.99	>10
3.95	13.0	29.02	1.95	Sandy Silt to Clayey Silt	ML	medium dense	115	8	35.9	55	42	34		
4.13	13.5	15.34	2.52	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		85			0.87	>10
4.28	14.0	17.20	4.77	Clay	CL/CH	stiff	125	14		100			0.97	>10
4.43	14.5	15.52	5.12	Clay	CL/CH	stiff	125	12		100			0.87	>10
4.58	15.0	16.77	5.17	Clay	CL/CH	stiff	125	13		100			0.95	>10
4.73	15.5	11.64	3.70	Silty Clay to Clay	CL	stiff	125	7		100			0.64	7.13
4.88	16.0	15.98	4.87	Clay	CL/CH	stiff	125	13		100			0.90	9.19
5.03	16.5	17.40	5.66	Clay	CL/CH	stiff	125	14		100			0.98	>10
5.18	17.0	11.67	5.21	Clay	CL/CH	stiff	125	9		100			0.64	5.00
5.33	17.5	16.43	5.75	Clay	CL/CH	stiff	125	13		100			0.92	8.56
5.48	18.0	18.67	5.42	Clay	CL/CH	very stiff	125	15		100			1.05	>10
5.65	18.5	20.55	5.44	Clay	CL/CH	very stiff	125	16		100			1.16	>10
5.80	19.0	16.55	4.65	Clay	CL/CH	stiff	125	13		100			0.93	7.85
5.95	19.5	44.50	2.88	Sandy Silt to Clayey Silt	ML	medium dense	115	13	47.8	60	51	35		
6.10	20.0	30.39	4.41	Silty Clay to Clay	CL	very stiff	125	17		85			1.74	>10
6.25	20.5	30.32	2.78	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		75			1.73	>10
6.40	21.0	19.93	5.44	Clay	CL/CH	very stiff	125	16		100			1.12	9.79
6.55	21.5	17.15	5.95	Clay	CL/CH	stiff	125	14		100			0.96	7.13
6.70	22.0	18.74	4.70	Clay	CL/CH	very stiff	125	15		100			1.05	8.14
6.85	22.5	22.50	3.98	Silty Clay to Clay	CL	very stiff	125	13		95			1.27	>10
7.00	23.0	25.06	2.89	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		85			1.42	>10
7.18	23.5	26.74	2.97	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		85			1.52	>10
7.33	24.0	27.99	3.00	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		80			1.59	>10
7.48	24.5	28.54	3.50	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		85			1.62	>10
7.63	25.0	25.53	3.37	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		90			1.44	>10
7.78	25.5	29.74	3.03	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		80			1.69	>10
7.93	26.0	27.46	4.40	Silty Clay to Clay	CL	very stiff	125	16		95			1.56	>10
8.08	26.5	103.93	2.00	Silty Sand to Sandy Silt	SM/ML	dense	115	23	99.8	40	72	38		
8.23	27.0	116.86	0.97	Sand to Silty Sand	SP/SM	dense	115	21	111.5	25	76	39		
8.38	27.5	56.45	2.35	Sandy Silt to Clayey Silt	ML	medium dense	115	16	53.5	55	54	36		
8.53	28.0	38.98	2.81	Sandy Silt to Clayey Silt	ML	medium dense	115	11	36.7	75	43	34		
8.68	28.5	46.95	2.27	Sandy Silt to Clayey Silt	ML	medium dense	115	13	43.9	60	48	35		
8.85	29.0	62.33	1.58	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	58.0	45	56	36		
9.00	29.5	80.94	0.99	Sand to Silty Sand	SP/SM	medium dense	115	15	74.9	30	64	37		
9.15	30.0	98.54	1.10	Sand to Silty Sand	SP/SM	medium dense	115	18	90.6	30	70	38		
9.30	30.5	50.36	2.62	Sandy Silt to Clayey Silt	ML	medium dense	115	14	46.0	65	50	35		
9.45	31.0	31.64	1.91	Sandy Silt to Clayey Silt	ML	loose	115	9	28.8	75	36	33		
9.60	31.5	30.01	2.72	Sandy Silt to Clayey Silt	ML	loose	115	9	27.1	85	34	33		
9.75	32.0	26.00	3.59	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.46	>10
9.90	32.5	30.62	3.49	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		90			1.73	>10
10.05	33.0	28.51	4.49	Silty Clay to Clay	CL	very stiff	125	16		100			1.61	>10
10.20	33.5	19.00	5.10	Clay	CL/CH	very stiff	125	15		100			1.05	4.89
10.38	34.0	20.30	5.09	Clay	CL/CH	very stiff	125	16		100			1.12	5.42
10.53	34.5	69.53	2.56	Sandy Silt to Clayey Silt	ML	medium dense	115	20	60.6	60	58	36		
10.68	35.0	29.76	3.97	Silty Clay to Clay	CL	very stiff	125	17		100			1.68	>10
10.83	35.5	18.93	4.76	Clay	CL/CH	very stiff	125	15		100			1.04	4.47
10.98	36.0	54.19	2.25	Sandy Silt to Clayey Silt	ML	medium dense	115	15	46.4	65	50	35		
11.13	36.5	44.69	2.11	Sandy Silt to Clayey Silt	ML	medium dense	115	13	38.0	70	44	34		
11.28	37.0	14.61	3.29	Silty Clay to Clay	CL	stiff	125	8		100			0.78	3.66
11.43	37.5	18.27	3.35	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			1.00	7.00
11.58	38.0	23.84	3.49	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.32	>10
11.73	38.5	73.74	2.27	Silty Sand to Sandy Silt	SM/ML	medium dense	115	16	61.4	55	58	36		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Centinela Solar Powerline -- Calexico, CA **Project No:** LE11210 **Date:** 9/27/2011

CONE SOUNDING: CPT-3

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	110.55	1.04	Sand to Silty Sand	SP/SM	medium dense	115	20	91.7	30	70	38		
12.05	39.5	56.64	2.63	Sandy Silt to Clayey Silt	ML	medium dense	115	16	46.7	65	50	35		
12.20	40.0	45.45	1.77	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	37.3	65	43	34		
12.35	40.5	17.90	2.94	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.97	6.10
12.50	41.0	42.21	5.08	Clay	CL/CH	hard	125	34		100			2.40	>10
12.65	41.5	239.92	0.83	Sand	SP	very dense	110	37	194.1	15	92	41		
12.80	42.0	324.01	0.43	Gravelly Sand to Sand	SW	very dense	115	43	261.1	5	101	42		
12.95	42.5	325.54	0.55	Gravelly Sand to Sand	SW	very dense	115	43	261.1	10	101	42		
13.10	43.0	313.94	0.89	Sand	SP	very dense	110	48	250.7	15	100	42		
13.25	43.5	336.58	1.12	Sand	SP	very dense	110	52	267.7	15	102	42		
13.40	44.0	381.24	1.36	Sand	SP	very dense	110	59	302.1	15	105	43		
13.58	44.5	423.37	1.64	Sand	SP	very dense	110	65	334.1	20	108	43		
13.73	45.0	485.51	1.55	Sand	SP	very dense	110	75	381.7	15	112	44		
13.88	45.5	420.20	1.67	Sand to Silty Sand	SP/SM	very dense	115	76	329.0	20	108	43		
14.03	46.0	292.76	1.72	Sand to Silty Sand	SP/SM	very dense	115	53	228.2	25	97	42		
14.18	46.5	200.40	2.05	Silty Sand to Sandy Silt	SM/ML	dense	115	45	155.6	35	86	40		
14.33	47.0	256.91	1.68	Sand to Silty Sand	SP/SM	very dense	115	47	198.6	25	93	41		
14.48	47.5	367.82	1.27	Sand	SP	very dense	110	57	283.3	15	103	42		
14.63	48.0	381.06	1.37	Sand	SP	very dense	110	59	292.4	20	104	43		
14.78	48.5	525.67	1.43	Sand	SP	very dense	110	81	401.8	15	114	44		

DEFINITION OF TERMS

PRIMARY DIVISIONS			SYMBOLS		SECONDARY DIVISIONS
Coarse grained soils More than half of material is larger that No. 200 sieve	**Gravels** More than half of coarse fraction is larger than No. 4 sieve	Clean gravels (less than 5% fines)		**GW**	Well graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly graded gravels, or gravel-sand mixtures, little or no fines
		Gravel with fines		**GM**	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	Sands More than half of coarse fraction is smaller than No. 4 sieve	Clean sands (less than 5% fines)		**SW**	Well graded sands, gravelly sands, little or no fines
				SP	Poorly graded sands or gravelly sands, little or no fines
		Sands with fines		**SM**	Silty sands, sand-silt mixtures, non-plastic fines
				SC	Clayey sands, sand-clay mixtures, plastic fines
Fine grained soils More than half of material is smaller than No. 200 sieve	**Silts and clays** Liquid limit is less than 50%			**ML**	Inorganic silts, clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravely, sandy, or lean clays
				OL	Organic silts and organic clays of low plasticity
	Silts and clays Liquid limit is more than 50%			**MH**	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils				**PT**	Peat and other highly organic soils

GRAIN SIZES

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		
200	40	10	4	3/4"	3"	12"	

US Standard Series Sieve — Clear Square Openings

Sands, Gravels, etc.	Blows/ft. *
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Clays & Plastic Silts	Strength **	Blows/ft. *
Very Soft	0-0.25	0-2
Soft	0.25-0.5	2-4
Firm	0.5-1.0	4-8
Stiff	1.0-2.0	8-16
Very Stiff	2.0-4.0	16-32
Hard	Over 4.0	Over 32

* Number of blows of 140 lb. hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 in. I.D.) split spoon (ASTM D1586).

** Unconfined compressive strength in tons/s.f. as determined by laboratory testing or approximated by the Standard Penetration Test (ASTM D1586), Pocket Penetrometer, Torvane, or visual observation.

Type of Samples:

Ring Sample — Standard Penetration Test — Shelby Tube — Bulk (Bag) Sample

Drilling Notes:

1. Sampling and Blow Counts
   - Ring Sampler - Number of blows per foot of a 140 lb. hammer falling 30 inches.
   - Standard Penetration Test - Number of blows per foot.
   - Shelby Tube - Three (3) inch nominal diameter tube hydraulically pushed.
2. P. P. = Pocket Penetrometer (tons/s.f.).
3. NR = No recovery.
4. GWT = Ground Water Table observed @ specified time.

LANDMARK
Geo-Engineers and Geologists

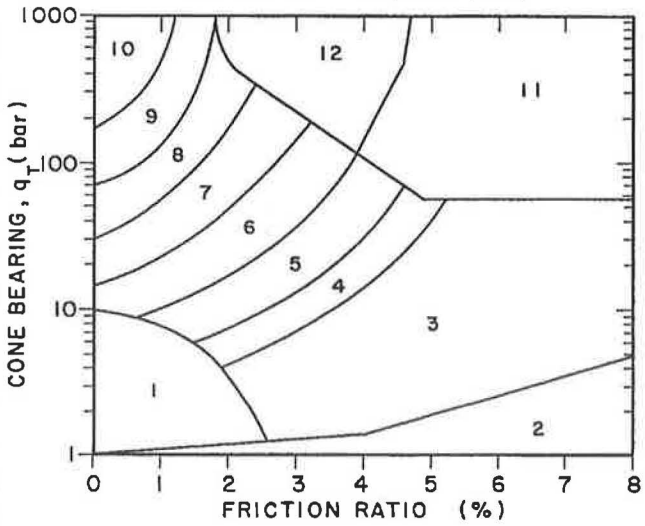
Project No. LE11210

Key to Logs

Plate
B-11

Simplified Soil Classification Chart

After Robertson & Campanella (1989)



Geotechnical Parameters from CPT Data:

Equivalent SPT N(60) blow count = Qc/(Qc/N Ratio)

N1(60) = Cn*N(60) Normalized SPT blow count

Cn = 1/(p'o)^0.5 < 1.6 max. from Liao & Whitman (1986)

p'o = effective overburden pressure (tsf) using unit densities given below and estimated groundwater table.

Dr = Relative density (%) from Jamiolkowski et. al. (1986) relationship

= -98 +68*log(Qc/p'o^0.5) where Qc, p'o in tonne/sqm

Note: 1 tonne/sqm = 0.1024 tsf, 1 bar =1.0443 tsf

Phi = Friction Angle estimated from either:

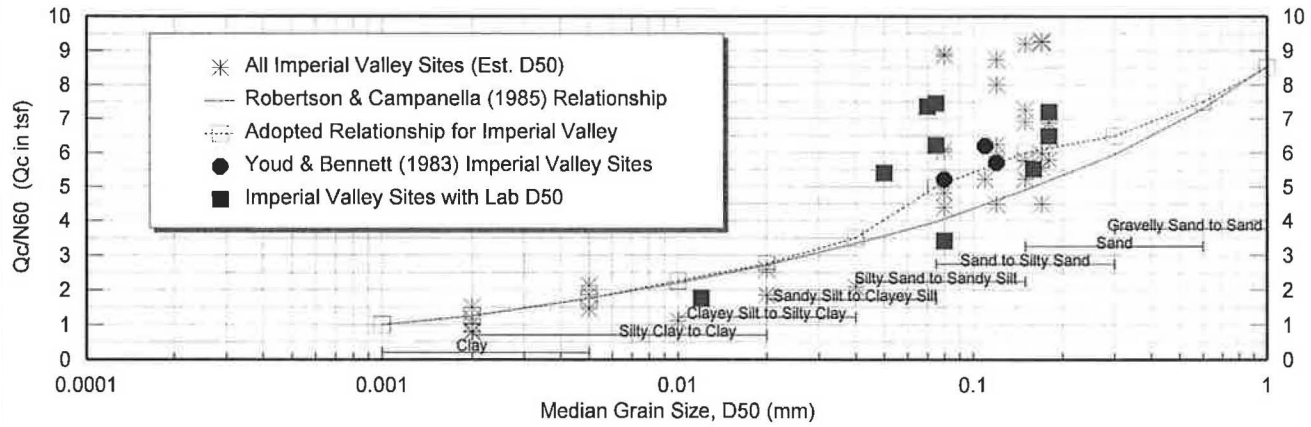
1. Roberton & Campanella (1983) chart:
   Phi = 5.3 + 24*(log(Qc/p'o))+3(log(Qc/p'o))^2
2. Peck, Hansen & Thornburn (1974) N-Phi Correlation
3. Schmertman (1978) chart [Phi = 28+0.14*Dr for fine uniform sands]

Su = undrained shear strength (tsf)

= (Qc-p'o)/Nk where Nk varies from 10 to 22, 17 for OC clays

OCR = Overconsolidation Ratio estimated from Schmertman (1978) chart using Su/p'o ratio and estimated normal consolidated Su/p'o

Variation of Qc/N Ratio with Grain Size



Note: Assumed Properties and Adopted Qc/N Ratio based on correlations from Imperial Valley, California soils

Table of Soil Types and Assumed Properties

Zone	Soil Classification	UCS	Density (pcf)	R&C Qc/N	Adopted Qc/N	Est. PI	Fines (%)	D50 (mm)	Su (tsf)	Consistency
1	Sensitive fine grained	ML	120	2	2	NP-15	65-100	0.020	0-0.13	very soft
2	Organic Material	OL/OH	120	1	1	--	--	--	0.13-.25	soft
3	Clay	CL/CH	125	1	1.25	25-40+	90-100	0.002	0.25-0.5	firm
4	Silty Clay to Clay	CL	125	1.5	2	15-40	90-100	0.010	0.5-1.0	stiff
5	Clayey Silt to Silty Clay	ML/CL	120	2	2.75	5-25	90-100	0.020	1.0-2.0	very stiff
6	Sandy Silt to Clayey Silt	ML	115	2.5	3.5	NP-10	65-100	0.040	>2.0	hard
7	Silty Sand to Sandy Silt	SM/ML	115	3	5	NP	35-75	0.075	Dr (%)	Relative Density
8	Sand to Silty Sand	SP/SM	115	4	6	NP	5-35	0.150	0-15	very loose
9	Sand	SP	110	5	6.5	NP	0-5	0.300	15-35	loose
10	Gravelly Sand to Sand	SW	115	6	7.5	NP	0-5	0.600	35-65	medium dense
11	Overconsolidated Soil	--	120	1	1	NP	90-100	0.010	65-85	dense
12	Sand to Clayey Sand	SP/SC	115	2	2	NP-5	--	---	>85	very dense

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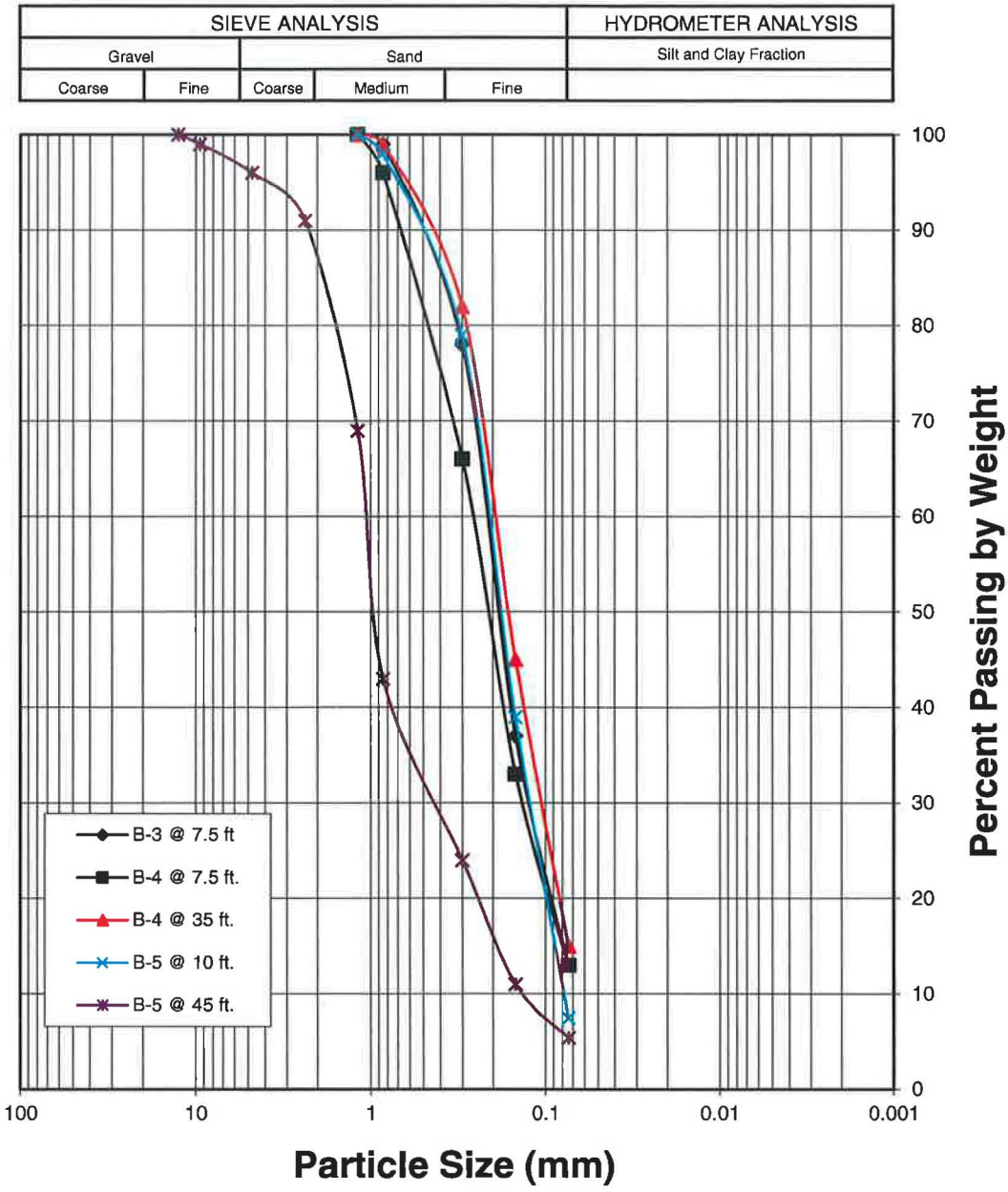
Key to CPT Interpretation of Logs

Plate B-12

APPENDIX C



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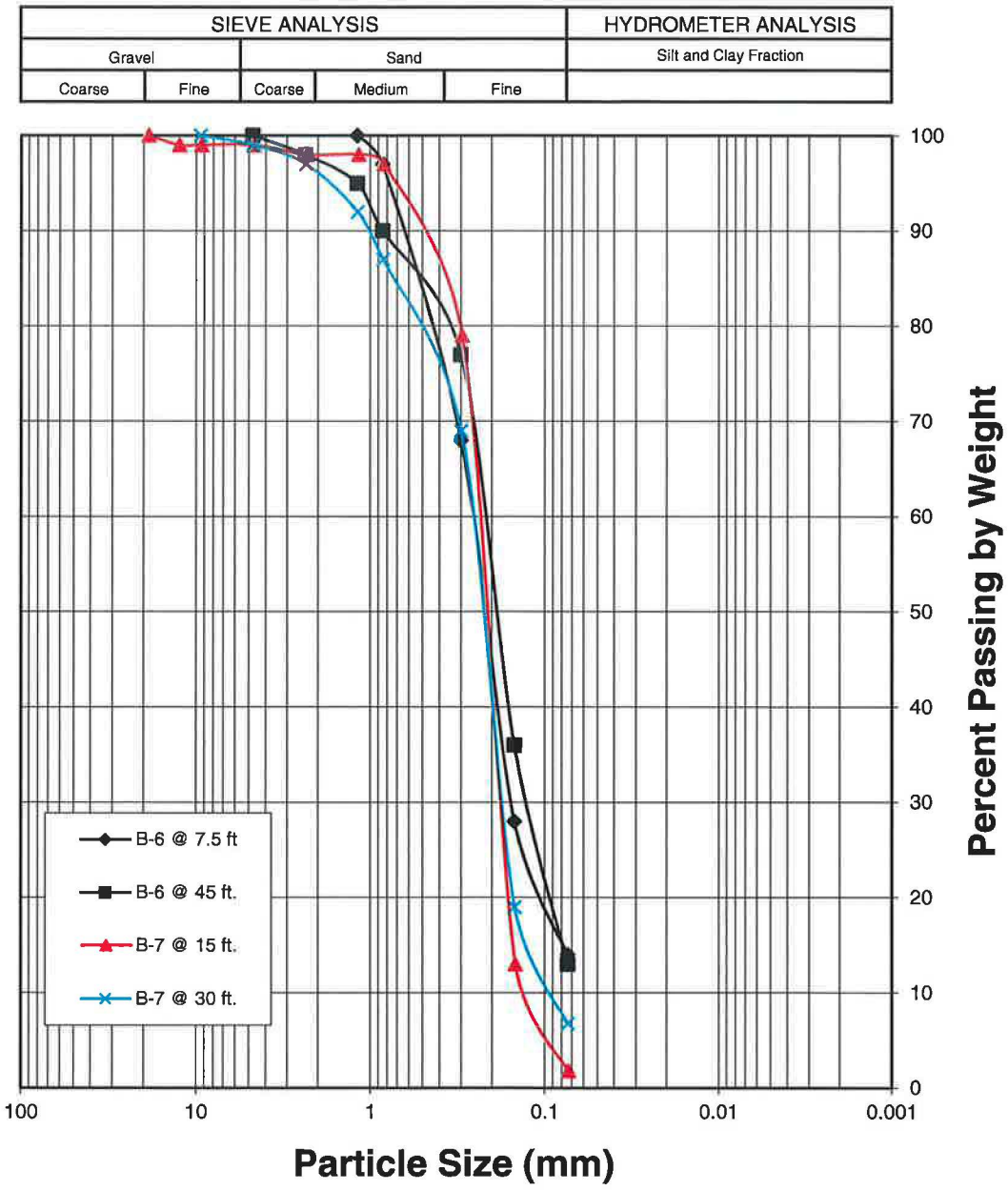
Project No.: LE11210

Grain Size Analysis

Plate C-1



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Project No.: LE11210

Grain Size Analysis

Plate C-2

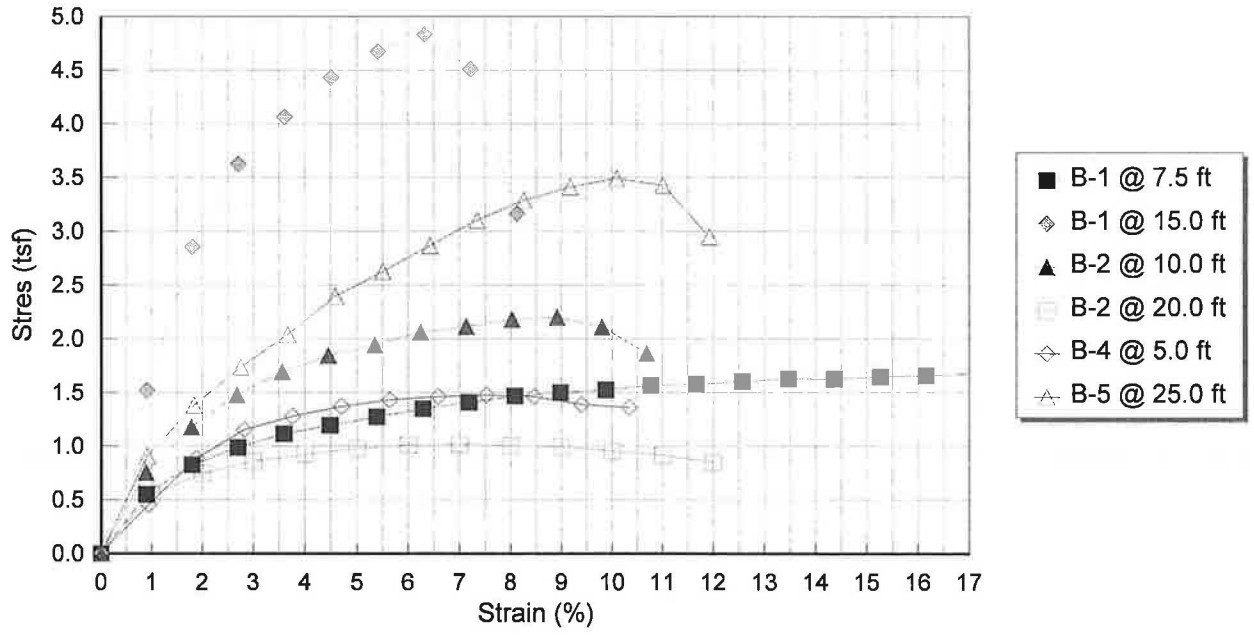
LANDMARK CONSULTANTS, INC.

CLIENT: Power Engineers
PROJECT: Centinela Solar Powerline
JOB NO: LE11210
DATE: 10/25/11

UNCONFINED COMPRESSION TEST (ASTM D2166)

Boring No.	Sample Depth (ft)	Natural Moisture Content (%)	Unit Dry Weight (pcf)	Maximum Compressive Strength (tsf)	Cohesion (tsf)	Failure Strain (%)
B-1	7.5	29.0	95.4	1.65	0.83	16.2
B-1	15.0	25.9	98.7	4.84	2.42	6.3
B-2	10.0	29.5	95.4	2.20	1.10	8.9
B-2	20.0	27.7	96.1	1.01	0.51	7.0
B-4	5.0	28.9	95.1	1.47	0.74	7.5
B-5	25.0	26.7	99.5	3.49	1.75	10.1

STRESS-STRAIN PLOT



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Project No: LE11210

Unconfined Compression Test Results

Plate C-3

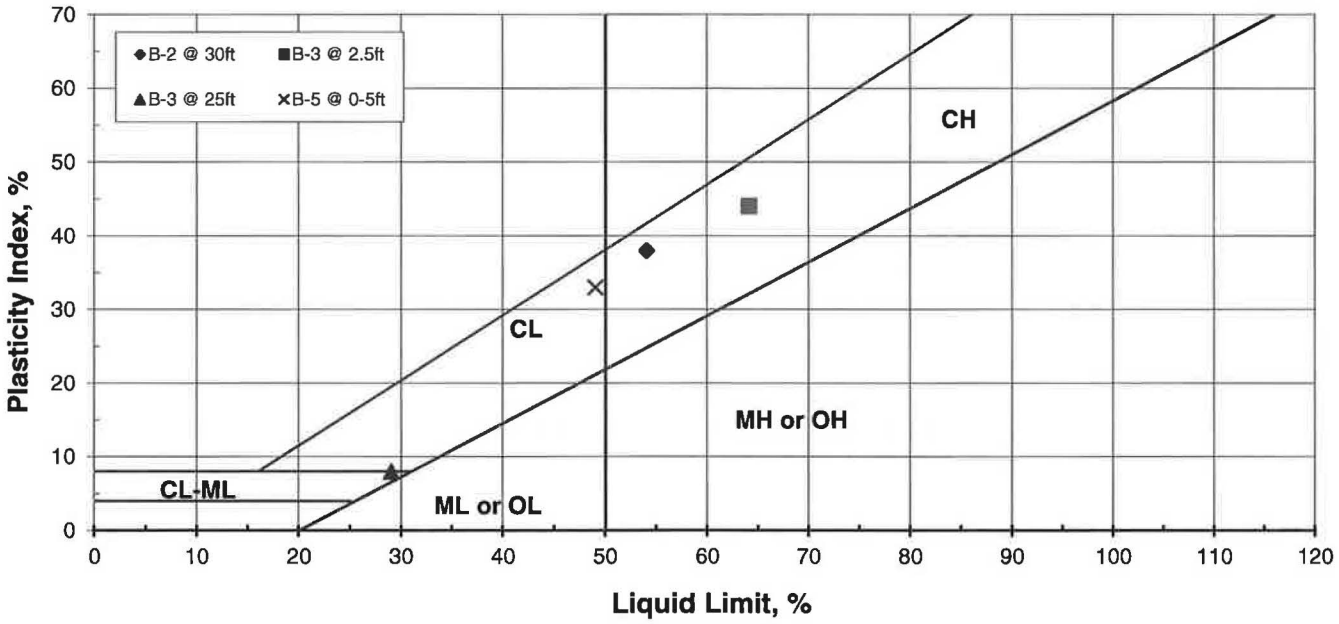
LANDMARK CONSULTANTS, INC.

CLIENT: Power Engineers
PROJECT: Centinela Solar Powerline -- Calexico, CA
JOB No.: LE11210
DATE: 10/25/11

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classification
B-2	30	54	16	38	CH
B-3	2.5	64	20	44	CH
B-3	25	29	21	8	CL-ML
B-5	0-5	49	16	33	CL

PLASTICITY CHART



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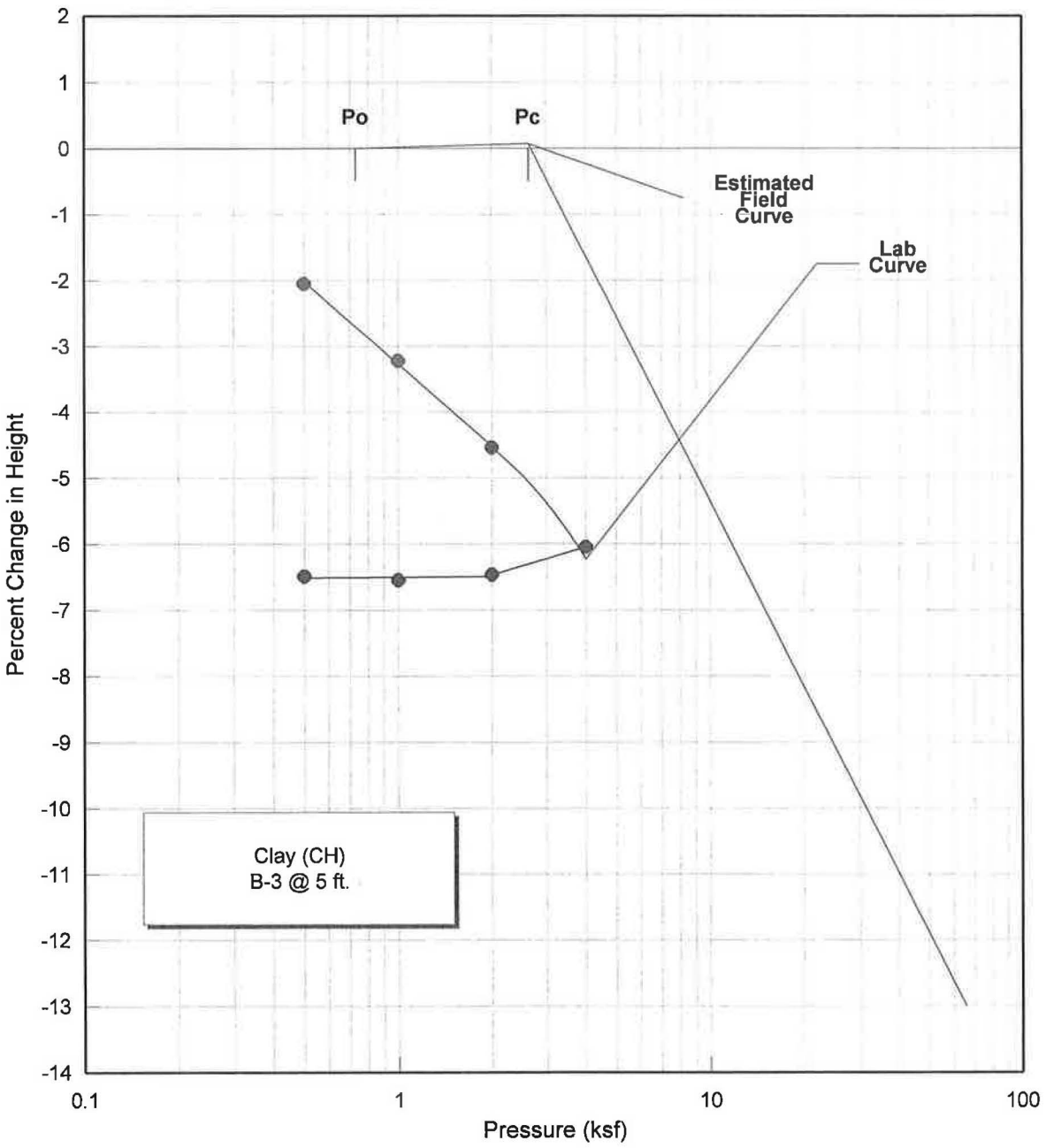
Project No.: LE11210

Atterberg Limits Test Results

Plate C-4

ONE DIMENSIONAL CONSOLIDATION TEST (ASTM D2435)



Results of Test:			Initial	Final
Overburden Pressure, Po:	0.7	ksf	Dry Density, pcf:	92.7	99.2
Preconsol. Pressure, Pc:	2.6	ksf	Water Content, %:	32.0	26.7
Compression Index, Cc:	0.173		Void Ratio, e:	0.853	0.731
Recompression. Index, Cr:	-0.002		Saturation, %:	103.2	100.0

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No: LE11210

Consolidation Test Results

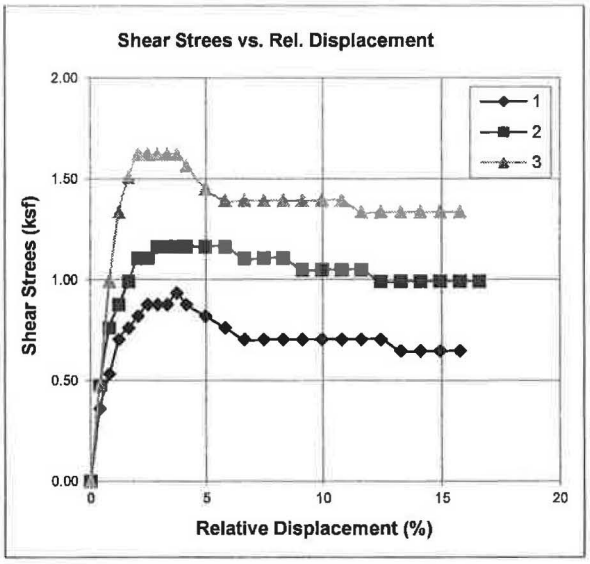
Plate C-5

LANDMARK CONSULTANTS, INC.

CLIENT: Power Engineers, Inc.
PROJECT: Centinela Solar Powerline
PROJECT No: LE11210 **DATE:** 10/25/2011

DIRECT SHEAR TEST - INSITU (ASTM D3080)

SAMPLE LOCATION: B-1 @ 35 ft
SAMPLE DESCRIPTION: SILTY SAND (SM)



	Specimen:	1	2	3	Avg.
Initial	Moisture Content, %:	**16.4**	**16.4**	**16.4**	**16.4**
	Dry Density, pcf:	**113.4**	**117.1**	**114.0**	**114.8**
	Saturation, %:	95	105	96	
Final	Moisture Content, %:	18.9	19.6	19.2	
	Dry Density, pcf:	113.5	116.0	111.7	
	Saturation, %:	109	122	106	
	Normal Stress, ksf:	**0.77**	**1.15**	**1.53**	
	Peak Shear Stress, ksf:	**0.93**	**1.16**	**1.62**	
	Residual Shear Stress, ksf:	0.65	0.99	1.33	
	Deformation Rate, in./min.	0.01	0.01	0.01	

	Peak	Residual	
Angle of Internal Friction, deg.:	**42**	**42**	
Cohesion, ksf:	**0.21**	**0.00**	

DIRECT SHEAR TEST RESULTS

LANDMARK
Geo-Engineers and Geologists
PROJECT No: LE11210

Direct Shear
Test Results

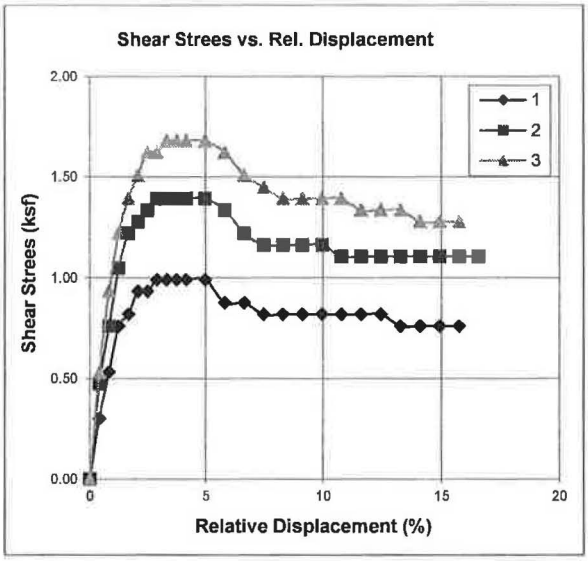
Plate
C-6

LANDMARK CONSULTANTS, INC.

CLIENT: Power Engineers, Inc.
PROJECT: Centinela Solar Powerline
PROJECT No: LE11210 **DATE:** 10/25/2011

DIRECT SHEAR TEST - INSITU (ASTM D3080)

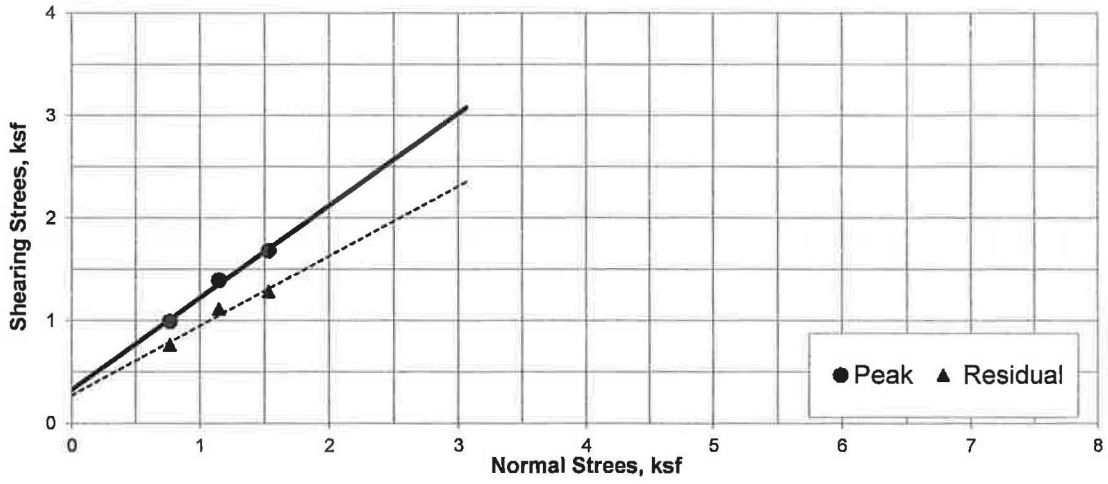
SAMPLE LOCATION: B-6 @ 10 ft
SAMPLE DESCRIPTION: SILTY SAND (SM)



	Specimen:	1	2	3	Avg.
Initial	Moisture Content, %:	**19.1**	**19.1**	**19.1**	**19.1**
	Dry Density, pcf:	**106.7**	**107.2**	**102.6**	**105.5**
	Saturation, %:	92	93	83	
Final	Moisture Content, %:	24.7	23.7	23.4	
	Dry Density, pcf:	103.2	105.0	100.6	
	Saturation, %:	108	109	96	
	Normal Stress, ksf:	**0.77**	**1.15**	**1.53**	
	Peak Shear Stress, ksf:	**0.99**	**1.39**	**1.68**	
	Residual Shear Stress, ksf:	0.76	1.11	1.28	
	Deformation Rate, in./min.	0.01	0.01	0.01	

	Peak	Residual	
Angle of Internal Friction, deg.:	**42**	**34**	
Cohesion, ksf:	**0.32**	**0.27**	

DIRECT SHEAR TEST RESULTS



LANDMARK
Geo-Engineers and Geologists

PROJECT No: LE11210

Direct Shear Test Results

Plate C-7

LANDMARK CONSULTANTS, INC.

CLIENT: Power Engineers
PROJECT: Centinela Solar Powerline -- Calexico, CA
JOB No.: LE11210
DATE: 10/25/11

CHEMICAL ANALYSIS

Boring:	B-1	B-2	B-3	B-5	B-6	B-7	Caltrans
Sample Depth, ft:	2.5	5	0-5	0-5	2.5	2.5	Method
pH:	8.1	8.5	7.8	7.8	8.6	8.5	643
Electrical Conductivity (mmhos):	3.45	1.08	3.63	2.59	0.24	0.24	424
Resistivity (ohm-cm):							643
Chloride (Cl), ppm:	2,380	310	1,240	730	30	30	422
Sulfate (SO4), ppm:	3,024	990	5,280	3,330	0	83	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble Sulfates	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

LANDMARK
Geo-Engineers and Geologists

Project No.: LE11210

Selected Chemical Test Results

Plate C-8

APPENDIX D

Liquefaction Evaluation and Settlement Calculation

Project Name: Centinela Solar Powerline
Project No.: LE11210
Location: B-1

Maximum Credible Earthquake	7
Design Ground Motion	0.40 g
Total Unit Weight,	115 pcf
Water Unit Weight,	62.4 pcf
Depth to Groundwater	4 ft
Hammer Effenciency	90
Required Factor of Safety	1.0

Boring Data						Sampling Corrections							Corrected	Fines	SPT Clean	Cyclical	Cyclical	Factor	Volumetric	Induced
Depth		Blow Counts		Liquefiable	Overburden	Sampler	SPT	Energy	Borehole	Rod	Liner	Overburden	SPT	Content	Sands	Resistance	Stress	of	Strain (%)	Subsidence
(ft)	(m)	SPT	Mod. Cal.	Soil (0 / 1)	Pressure	Diameter	N_m	C_E	C_B	C_R	C_L	C_N	$(N_1)_{60}$	%	$(N_1)_{60CS}$	$CRR_{M7.5}$	CSR	Safety		(inch)
2.5	0.76		16	0	288	0.67	11	1.5	1.0	0.75	1	2.64	32	100	43		0.259	Non-Liq.	0.00	0.00
5	1.52	7		0	513	1	7	1.5	1.0	0.75	1.1	1.98	17	100	26	0.292	0.289	1.20	0.00	0.00
7.5	2.29		18	0	644	0.67	12	1.5	1.0	0.75	1	1.76	24	100	34		0.343	Non-Liq.	0.00	0.00
10	3.05	6		1	776	1	6	1.5	1.0	0.80	1.1	1.61	13	98	20	0.219	0.377	0.69	1.57	0.47
15	4.57		34	0	1039	0.67	23	1.5	1.0	0.85	1	1.39	40	100	53		0.418	Non-Liq.	0.00	0.00
20	6.10	10		0	1302	1	10	1.5	1.0	0.95	1.1	1.24	19	100	28	0.352	0.440	0.95	0.00	0.00
25	7.62		23	0	1565	0.67	15	1.5	1.0	0.95	1	1.13	25	100	35		0.450	Non-Liq.	0.00	0.00
30	9.14	18		1	1828	1	18	1.5	1.0	0.95	1.1	1.05	30	15	33		0.452	Non-Liq.	0.00	0.00
35	10.67		28	1	2091	0.67	19	1.5	1.0	1.00	1	0.98	28	15	31		0.446	Non-Liq.	0.00	0.00
40	12.19	22		0	2354	1	22	1.5	1.0	1.00	1.1	0.92	33	100	45		0.432	Non-Liq.	0.00	0.00
45	13.72		47	1	2617	0.67	31	1.5	1.0	1.00	1	0.87	41	95	55		0.413	Non-Liq.	0.00	0.00
50	15.24	8		0	2880	1	8	1.5	1.0	1.00	1.1	0.83	11	80	18	0.196	0.391	0.60	0.00	0.00

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997.

Total Settlement **0.47**

Corrections to SPT (Modified from Skempton, 1986) as listed by Robertson and Wride.

Factor	Equipment Variable	Term	Correction
Overburden Pressure		C_N	$(P_a/\sigma_{VO})^{0.5}$ C_N<=2
Energy Ratio	Donut Hammer	C_E	0.5 to 1.0
	Safety Hammer		0.7 to 1.2
	Automatic-trip Donut type Hammer		0.8 to 1.3
Borehole Diameter	2.6 inch to 6 inch	C_B	1
	6 inch		1.05
	8 inch		1.15
Rod Length	10 feet to 13 feet	C_R	0.75
	13 feet to 19.8 ft.		0.85
	19.8 ft. to 33 ft.		0.95
	33 ft. to 98 ft.		1
	> 98 ft.		<1.0
Sampling Method	Standard Sampler	C_L	1
	Sampler without liners		1.1 to 1.3

Liquefaction Evaluation and Settlement Calculation

Project Name: Centinela Solar Powerline
Project No.: LE11210
Location: B-2

Maximum Credible Earthquake	7
Design Ground Motion	0.40 g
Total Unit Weight,	115 pcf
Water Unit Weight,	62.4 pcf
Depth to Groundwater	4 ft
Hammer Effenciency	90
Required Factor of Safety	1.0

Boring Data						Sampling Corrections														
Depth		Blow Counts		Liquefiable	Overburden	Sampler	SPT	Energy	Borehole	Rod	Liner	Overburden	Corrected SPT	Fines Content	SPT Clean Sands	Cyclical Resistance	Cyclical Stress	Factor of	Volumetric Strain (%)	Induced Subsidence
(ft)	(m)	SPT	Mod. Cal.	Soil (0 / 1)	Pressure	Diameter	N_m	C_E	C_B	C_R	C_L	C_N	$(N_1)_{60}$	%	$(N_1)_{60CS}$	$CRR_{M7.5}$	CSR	Safety		(inch)
2.5	0.76	10		0	288	1	10	1.5	1.0	0.75	1.1	2.64	33	100	44		0.259	Non-Liq.	0.00	0.00
5	1.52		16	0	513	0.67	11	1.5	1.0	0.75	1	1.98	24	100	34		0.289	Non-Liq.	0.00	0.00
7.5	2.29	14		1	644	1	14	1.5	1.0	0.75	1.1	1.76	31	25	38		0.343	Non-Liq.	0.00	0.00
10	3.05		28	0	776	0.67	19	1.5	1.0	0.80	1	1.61	36	100	48		0.377	Non-Liq.	0.00	0.00
15	4.57	13		1	1039	1	13	1.5	1.0	0.85	1.1	1.39	25	80	35		0.418	Non-Liq.	0.00	0.00
20	6.10		3	0	1302	0.67	2	1.5	1.0	0.95	1	1.24	4	100	9	0.101	0.440	0.27	0.00	0.00
25	7.62	15		0	1565	1	15	1.5	1.0	0.95	1.1	1.13	27	100	37		0.450	Non-Liq.	0.00	0.00
30	9.14		6	0	1828	0.67	4	1.5	1.0	0.95	1	1.05	6	100	12	0.132	0.452	0.35	0.00	0.00
35	10.67	14		0	2091	1	14	1.5	1.0	1.00	1.1	0.98	23	100	32		0.446	Non-Liq.	0.00	0.00
40	12.19		12	0	2354	0.67	8	1.5	1.0	1.00	1	0.92	11	100	18	0.198	0.432	0.55	0.00	0.00
45	13.72	23		0	2617	1	23	1.5	1.0	1.00	1.1	0.87	33	22	40		0.413	Non-Liq.	0.00	0.00
50	15.24		34	1	2880	0.67	23	1.5	1.0	1.00	1	0.83	28	20	34		0.391	Non-Liq.	0.00	0.00

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997.

Total Settlement **0.00**

Corrections to SPT (Modified from Skempton, 1986) as listed by Robertson and Wride.

Factor	Equipment Variable	Term	Correction
Overburden Pressure		C_N	$(P_a/\sigma_{VO})^{0.5}$ C_N<=2
Energy Ratio	Donut Hammer	C_E	0.5 to 1.0
	Safety Hammer		0.7 to 1.2
	Automatic-trip Donut type Hammer		0.8 to 1.3
Borehole Diameter	2.6 inch to 6 inch	C_B	1
	6 inch		1.05
	8 inch		1.15
Rod Length	10 feet to 13 feet	C_R	0.75
	13 feet to 19.8 ft.		0.85
	19.8 ft. to 33 ft.		0.95
	33 ft. to 98 ft.		1
	> 98 ft.		<1.0
Sampling Method	Standard Sampler	C_L	1
	Sampler without liners		1.1 to 1.3

Liquefaction Evaluation and Settlement Calculation

Project Name: Centinela Solar Powerline
Project No.: LE11210
Location: B-3

Maximum Credible Earthquake	7
Design Ground Motion	0.40 g
Total Unit Weight,	115 pcf
Water Unit Weight,	62.4 pcf
Depth to Groundwater	4 ft
Hammer Effenciency	90
Required Factor of Safety	1.0

Boring Data						Sampling Corrections							Corrected	Fines	SPT Clean	Cyclical	Cyclical	Factor	Volumetric	Induced
Depth		Blow Counts		Liquefiable	Overburden	Sampler	SPT	Energy	Borehole	Rod	Liner	Overburden	SPT	Content	Sands	Resistance	Stress	of	Strain (%)	Subsidence
(ft)	(m)	SPT	Mod. Cal.	Soil (0 / 1)	Pressure	Diameter	N_m	C_E	C_B	C_R	C_L	C_N	$(N_1)_{60}$	%	$(N_1)_{60CS}$	$CRR_{M7.5}$	CSR	Safety		(inch)
2.5	0.76	5		0	288	1	5	1.5	1.0	0.75	1.1	2.64	16	100	25	0.276	0.259	Non-Liq.	0.00	0.00
5	1.52		17	0	513	0.67	11	1.5	1.0	0.75	1	1.98	25	100	35		0.289	Non-Liq.	0.00	0.00
7.5	2.29	14		1	644	1	14	1.5	1.0	0.75	1.1	1.76	31	13	34		0.343	Non-Liq.	0.00	0.00
10	3.05		14	0	776	0.67	9	1.5	1.0	0.80	1	1.61	18	100	27	0.313	0.377	0.99	0.00	0.00
15	4.57	10		0	1039	1	10	1.5	1.0	0.85	1.1	1.39	19	100	28	0.353	0.418	1.01	0.00	0.00
20	6.10		27	0	1302	0.67	18	1.5	1.0	0.95	1	1.24	32	100	43		0.440	Non-Liq.	0.00	0.00
25	7.62	9		1	1565	1	9	1.5	1.0	0.95	1.1	1.13	16	95	24	0.269	0.450	0.71	1.28	0.77
30	9.14		18	1	1828	0.67	12	1.5	1.0	0.95	1	1.05	18	95	27	0.311	0.452	0.82	1.14	0.68
35	10.67	8		0	2091	1	8	1.5	1.0	1.00	1.1	0.98	13	100	20	0.222	0.446	0.59	0.00	0.00
40	12.19		15	0	2354	0.67	10	1.5	1.0	1.00	1	0.92	14	75	22	0.236	0.432	0.65	0.00	0.00

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997.

Total Settlement **1.45**

Corrections to SPT (Modified from Skempton, 1986) as listed by Robertson and Wride.

Factor	Equipment Variable	Term	Correction
Overburden Pressure		C_N	$(P_a/\sigma_{VO})^{0.5}$ $C_N<=2$
Energy Ratio	Donut Hammer	C_E	0.5 to 1.0
	Safety Hammer		0.7 to 1.2
	Automatic-trip Donut type Hammer		0.8 to 1.3
Borehole Diameter	2.6 inch to 6 inch	C_B	1
	6 inch		1.05
	8 inch		1.15
Rod Length	10 feet to 13 feet	C_R	0.75
	13 feet to 19.8 ft.		0.85
	19.8 ft. to 33 ft.		0.95
	33 ft. to 98 ft.		1
	> 98 ft.		<1.0
Sampling Method	Standard Sampler	C_L	1
	Sampler without liners		1.1 to 1.3

Liquefaction Evaluation and Settlement Calculation

Project Name: Centinela Solar Powerline
Project No.: LE11210
Location: B-4

Maximum Credible Earthquake	7
Design Ground Motion	0.40 g
Total Unit Weight,	115 pcf
Water Unit Weight,	62.4 pcf
Depth to Groundwater	4 ft
Hammer Effenciency	90
Required Factor of Safety	1.0

Boring Data						Sampling Corrections							Corrected	Fines	SPT Clean	Cyclical	Cyclical	Factor	Volumetric	Induced
Depth		Blow Counts		Liquefiable	Overburden	Sampler	SPT	Energy	Borehole	Rod	Liner	Overburden	SPT	Content	Sands	Resistance	Stress	of	Strain (%)	Subsidence
(ft)	(m)	SPT	Mod. Cal.	Soil (0 / 1)	Pressure	Diameter	N_m	C_E	C_B	C_R	C_L	C_N	$(N_1)_{60}$	%	$(N_1)_{60CS}$	$CRR_{M7.5}$	CSR	Safety		(inch)
2.5	0.76	4		0	288	1	4	1.5	1.0	0.75	1.1	2.64	13	100	21	0.224	0.259	Non-Liq.	0.00	0.00
5	1.52		15	0	513	0.67	10	1.5	1.0	0.75	1	1.98	22	100	32		0.289	Non-Liq.	0.00	0.00
7.5	2.29	19		1	644	1	19	1.5	1.0	0.75	1.1	1.76	41	13	45		0.343	Non-Liq.	0.00	0.00
10	3.05		31	1	776	0.67	21	1.5	1.0	0.80	1	1.61	40	13	43		0.377	Non-Liq.	0.00	0.00
15	4.57	14		0	1039	1	14	1.5	1.0	0.85	1.1	1.39	27	100	38		0.418	Non-Liq.	0.00	0.00
20	6.10		31	0	1302	0.67	21	1.5	1.0	0.95	1	1.24	37	100	49		0.440	Non-Liq.	0.00	0.00
25	7.62	10		1	1565	1	10	1.5	1.0	0.95	1.1	1.13	18	95	26	0.305	0.450	0.81	1.14	0.68
30	9.14		28	0	1828	0.67	19	1.5	1.0	0.95	1	1.05	28	100	39		0.452	Non-Liq.	0.00	0.00
35	10.67	7		1	2091	1	7	1.5	1.0	1.00	1.1	0.98	11	15	14	0.155	0.446	0.42	2.00	0.72
40	12.19		24	0	2354	0.67	16	1.5	1.0	1.00	1	0.92	22	15	26	0.296	0.432	0.82	0.00	0.00
45	13.72	48		0	2617	1	48	1.5	1.0	1.00	1.1	0.87	69	100	88		0.413	Non-Liq.	0.00	0.00

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997.

Total Settlement **1.40**

Corrections to SPT (Modified from Skempton, 1986) as listed by Robertson and Wride.

Factor	Equipment Variable	Term	Correction
Overburden Pressure		C_N	$(P_a/\sigma_{VO})^{0.5}$ $C_N<=2$
Energy Ratio	Donut Hammer	C_E	0.5 to 1.0
	Safety Hammer		0.7 to 1.2
	Automatic-trip Donut type Hammer		0.8 to 1.3
Borehole Diameter	2.6 inch to 6 inch	C_B	1
	6 inch		1.05
	8 inch		1.15
Rod Length	10 feet to 13 feet	C_R	0.75
	13 feet to 19.8 ft.		0.85
	19.8 ft. to 33 ft.		0.95
	33 ft. to 98 ft.		1
	> 98 ft.		<1.0
Sampling Method	Standard Sampler	C_L	1
	Sampler without liners		1.1 to 1.3

Liquefaction Evaluation and Settlement Calculation

Project Name: Centinela Solar Powerline
Project No.: LE11210
Location: B-5

Maximum Credible Earthquake	7
Design Ground Motion	0.40 g
Total Unit Weight,	115 pcf
Water Unit Weight,	62.4 pcf
Depth to Groundwater	4 ft
Hammer Effenciency	90
Required Factor of Safety	1.0

Boring Data						Sampling Corrections							Corrected	Fines	SPT Clean	Cyclical	Cyclical	Factor	Volumetric	Induced
Depth		Blow Counts		Liquefiable	Overburden	Sampler	SPT	Energy	Borehole	Rod	Liner	Overburden	SPT	Content	Sands	Resistance	Stress	of	Strain (%)	Subsidence
(ft)	(m)	SPT	Mod. Cal.	Soil (0 / 1)	Pressure	Diameter	N_m	C_E	C_B	C_R	C_L	C_N	$(N_1)_{60}$	%	$(N_1)_{60CS}$	$CRR_{M7.5}$	CSR	Safety		(inch)
2.5	0.76		8	0	288	0.67	5	1.5	1.0	0.75	1	2.64	16	100	24	0.268	0.259	Non-Liq.	0.00	0.00
5	1.52	11		0	513	1	11	1.5	1.0	0.75	1.1	1.98	27	100	37		0.289	Non-Liq.	0.00	0.00
7.5	2.29		19	1	644	0.67	13	1.5	1.0	0.75	1	1.76	25	8	26	0.297	0.343	1.03	0.00	0.00
10	3.05	5		1	776	1	5	1.5	1.0	0.80	1.1	1.61	11	8	11	0.119	0.377	0.38	2.40	0.72
15	4.57		17	0	1039	0.67	11	1.5	1.0	0.85	1	1.39	20	100	29	0.383	0.418	1.09	0.00	0.00
20	6.10	9		0	1302	1	9	1.5	1.0	0.95	1.1	1.24	17	100	26	0.300	0.440	0.81	0.00	0.00
25	7.62		29	0	1565	0.67	19	1.5	1.0	0.95	1	1.13	31	100	43		0.450	Non-Liq.	0.00	0.00
30	9.14	11		0	1828	1	11	1.5	1.0	0.95	1.1	1.05	18	100	27	0.312	0.452	0.82	0.00	0.00
35	10.67		27	0	2091	0.67	18	1.5	1.0	1.00	1	0.98	27	100	37		0.446	Non-Liq.	0.00	0.00
40	12.19	7		1	2354	1	7	1.5	1.0	1.00	1.1	0.92	11	15	14	0.148	0.432	0.41	2.15	1.29
45	13.72		70	1	2617	0.67	47	1.5	1.0	1.00	1	0.87	62	5	62		0.413	Non-Liq.	0.00	0.00
50	15.24	58		1	2880	1	58	1.5	1.0	1.00	1.1	0.83	80	15	86		0.391	Non-Liq.	0.00	0.00

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997.

Total Settlement **2.01**

Corrections to SPT (Modified from Skempton, 1986) as listed by Robertson and Wride.

Factor	Equipment Variable	Term	Correction
Overburden Pressure		C_N	$(P_a/\sigma_{VO})^{0.5}$ C_N<=2
Energy Ratio	Donut Hammer	C_E	0.5 to 1.0
	Safety Hammer		0.7 to 1.2
	Automatic-trip Donut type Hammer		0.8 to 1.3
Borehole Diameter	2.6 inch to 6 inch	C_B	1
	6 inch		1.05
	8 inch		1.15
Rod Length	10 feet to 13 feet	C_R	0.75
	13 feet to 19.8 ft.		0.85
	19.8 ft. to 33 ft.		0.95
	33 ft. to 98 ft.		1
	> 98 ft.		<1.0
Sampling Method	Standard Sampler	C_L	1
	Sampler without liners		1.1 to 1.3

Liquefaction Evaluation and Settlement Calculation

Project Name: Centinela Solar Powerline
Project No.: LE11210
Location: B-6

Maximum Credible Earthquake	7
Design Ground Motion	0.40 g
Total Unit Weight,	115 pcf
Water Unit Weight,	62.4 pcf
Depth to Groundwater	6 ft
Hammer Effenciency	90
Required Factor of Safety	1.0

Boring Data						Sampling Corrections							Corrected	Fines	SPT Clean	Cyclical	Cyclical	Factor	Volumetric	Induced
Depth		Blow Counts		Liquefiable	Overburden	Sampler	SPT	Energy	Borehole	Rod	Liner	Overburden	SPT	Content	Sands	Resistance	Stress	of	Strain (%)	Subsidence
(ft)	(m)	SPT	Mod. Cal.	Soil (0 / 1)	Pressure	Diameter	N_m	C_E	C_B	C_R	C_L	C_N	$(N_1)_{60}$	%	$(N_1)_{60CS}$	$CRR_{M7.5}$	CSR	Safety		(inch)
2.5	0.76	6		1	288	1	6	1.5	1.0	0.75	1.1	2.64	20	15	23	0.253	0.259	Non-Liq.	0.00	0.00
5	1.52		20	1	575	0.67	13	1.5	1.0	0.75	1	1.87	28	15	32		0.257	Non-Liq.	0.00	0.00
7.5	2.29	5		1	769	1	5	1.5	1.0	0.75	1.1	1.61	10	14	13	0.136	0.287	0.57	2.30	0.69
10	3.05		32	1	900	0.67	21	1.5	1.0	0.80	1	1.49	38	14	42		0.325	Non-Liq.	0.00	0.00
15	4.57	15		0	1163	1	15	1.5	1.0	0.85	1.1	1.31	28	100	38		0.373	Non-Liq.	0.00	0.00
20	6.10		15	1	1426	0.67	10	1.5	1.0	0.95	1	1.18	17	80	25	0.288	0.401	0.86	1.21	0.73
25	7.62	5		1	1689	1	5	1.5	1.0	0.95	1.1	1.09	9	80	15	0.165	0.417	0.47	1.91	0.69
30	9.14		12	1	1952	0.67	8	1.5	1.0	0.95	1	1.01	12	80	19	0.204	0.423	0.58	1.71	0.62
35	10.67	10		0	2215	1	10	1.5	1.0	1.00	1.1	0.95	16	100	24	0.264	0.421	0.75	0.00	0.00
40	12.19		24	0	2478	0.67	16	1.5	1.0	1.00	1	0.90	22	100	31		0.411	Non-Liq.	0.00	0.00
45	13.72	20		1	2741	1	20	1.5	1.0	1.00	1.1	0.85	28	13	31		0.394	Non-Liq.	0.00	0.00
50	15.24		48	1	3004	0.67	32	1.5	1.0	1.00	1	0.82	39	15	44		0.375	Non-Liq.	0.00	0.00

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997.

Total Settlement **2.72**

Corrections to SPT (Modified from Skempton, 1986) as listed by Robertson and Wride.

Factor	Equipment Variable	Term	Correction
Overburden Pressure		C_N	$(P_a/\sigma_{VO})^{0.5}$ C_N<=2
Energy Ratio	Donut Hammer	C_E	0.5 to 1.0
	Safety Hammer		0.7 to 1.2
	Automatic-trip Donut type Hammer		0.8 to 1.3
Borehole Diameter	2.6 inch to 6 inch	C_B	1
	6 inch		1.05
	8 inch		1.15
Rod Length	10 feet to 13 feet	C_R	0.75
	13 feet to 19.8 ft.		0.85
	19.8 ft. to 33 ft.		0.95
	33 ft. to 98 ft.		1
	> 98 ft.		<1.0
Sampling Method	Standard Sampler	C_L	1
	Sampler without liners		1.1 to 1.3

Liquefaction Evaluation and Settlement Calculation

Project Name: Centinela Solar Powerline
Project No.: LE11210
Location: B-7

Maximum Credible Earthquake	7
Design Ground Motion	0.40 g
Total Unit Weight,	115 pcf
Water Unit Weight,	62.4 pcf
Depth to Groundwater	18 ft
Hammer Effenciency	90
Required Factor of Safety	1.0

Boring Data						Sampling Corrections							Corrected	Fines	SPT Clean	Cyclical	Cyclical	Factor	Volumetric	Induced
Depth		Blow Counts		Liquefiable	Overburden	Sampler	SPT	Energy	Borehole	Rod	Liner	Overburden	SPT	Content	Sands	Resistance	Stress	of	Strain (%)	Subsidence
(ft)	(m)	SPT	Mod. Cal.	Soil (0 / 1)	Pressure	Diameter	N_m	C_E	C_B	C_R	C_L	C_N	$(N_1)_{60}$	%	$(N_1)_{60CS}$	$CRR_{M7.5}$	CSR	Safety		(inch)
2.5	0.76		17	1	288	0.67	11	1.5	1.0	0.75	1	2.64	34	15	38		0.259	Non-Liq.	0.00	0.00
5	1.52	15		1	575	1	15	1.5	1.0	0.75	1.1	1.87	35	15	39		0.257	Non-Liq.	0.00	0.00
7.5	2.29		43	0	863	0.67	29	1.5	1.0	0.75	1	1.52	49	100	64		0.256	Non-Liq.	0.00	0.00
10	3.05	18		1	1150	1	18	1.5	1.0	0.80	1.1	1.32	31	5	31		0.255	Non-Liq.	0.00	0.00
15	4.57		17	1	1725	0.67	11	1.5	1.0	0.85	1	1.08	16	2	16	0.169	0.252	Non-Liq.	0.00	0.00
20	6.10	37		1	2175	1	37	1.5	1.0	0.95	1.1	0.96	56	5	56		0.263	Non-Liq.	0.00	0.00
25	7.62		100	1	2438	0.67	67	1.5	1.0	0.95	1	0.91	86	5	87		0.289	Non-Liq.	0.00	0.00
30	9.14	46		1	2701	1	46	1.5	1.0	0.95	1.1	0.86	62	7	63		0.306	Non-Liq.	0.00	0.00
35	10.67		32	1	2964	0.67	21	1.5	1.0	1.00	1	0.82	26	7	27	0.315	0.314	1.19	0.00	0.00
40	12.19	100		1	3227	1	100	1.5	1.0	1.00	1.1	0.79	130	5	130		0.315	Non-Liq.	0.00	0.00
45	13.72		100	1	3490	0.67	67	1.5	1.0	1.00	1	0.76	76	5	76		0.310	Non-Liq.	0.00	0.00
50	15.24	20		1	3753	1	20	1.5	1.0	1.00	1.1	0.73	24	5	24	0.269	0.300	1.07	0.00	0.00

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997.

Total Settlement **0.00**

Corrections to SPT (Modified from Skempton, 1986) as listed by Robertson and Wride.

Factor	Equipment Variable	Term	Correction
Overburden Pressure		C_N	$(P_a/\sigma_{VO})^{0.5}$ C_N<=2
Energy Ratio	Donut Hammer	C_E	0.5 to 1.0
	Safety Hammer		0.7 to 1.2
	Automatic-trip Donut type Hammer		0.8 to 1.3
Borehole Diameter	2.6 inch to 6 inch	C_B	1
	6 inch		1.05
	8 inch		1.15
Rod Length	10 feet to 13 feet	C_R	0.75
	13 feet to 19.8 ft.		0.85
	19.8 ft. to 33 ft.		0.95
	33 ft. to 98 ft.		1
	> 98 ft.		<1.0
Sampling Method	Standard Sampler	C_L	1
	Sampler without liners		1.1 to 1.3

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-1
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft
PGA: 0.40 g
Estimated Earthquake Magnitude: 7.0
Magnitude Scaling Factor: 1.19
Required FS: 1.0
Limiting Qc1n-cs for liquefiable soils: 164
Limiting Ic for liquefiable soils: 2.55
Total Estimated Settlement: 2.38

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{c1N}	Ic	Kc	$(Q_{c1N})_{cs}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
0	0.00														
0.05	0.16	1.15	0.152	13.41	0.010	120	2.17	2.73	4.23	9.2	0.260	0.058	0.264	0.00	0.00
0.1	0.33	1.62	0.376	23.38	0.020	120	3.06	3.02	7.00	21.4	0.260	0.068	0.311	0.00	0.00
0.15	0.49	27.37	0.9	3.30	0.029	115	51.74	2.15	1.55	80.4	0.260	0.128	0.588	0.00	0.00
0.2	0.66	28.49	1.141	4.02	0.039	115	53.86	2.25	1.78	96.1	0.260	0.163	0.745	0.00	0.00
0.25	0.82	18.39	1.212	6.60	0.048	120	34.76	2.56	3.10	107.7	0.260	0.196	0.899	0.00	0.00
0.3	0.98	16.48	1.03	6.26	0.058	120	31.15	2.60	3.31	103.2	0.260	0.182	0.836	0.00	0.00
0.35	1.15	13.19	0.891	6.77	0.068	120	31.93	2.56	3.10	99.0	0.260	0.170	0.781	0.00	0.00
0.4	1.31	11.1	0.655	5.92	0.078	120	27.15	2.59	3.25	88.3	0.260	0.144	0.662	0.00	0.00
0.45	1.48	9.13	0.448	4.92	0.088	120	22.51	2.61	3.38	76.0	0.260	0.121	0.555	0.00	0.00
0.5	1.64	7.48	0.431	5.77	0.098	120	19.38	2.74	4.31	83.5	0.260	0.134	0.616	0.00	0.00
0.55	1.80	7.04	0.428	6.10	0.107	120	13.31	2.60	3.35	44.6	0.259	0.087	0.401	0.00	0.00
0.6	1.97	7.87	0.462	5.88	0.117	120	20.61	2.77	4.54	93.7	0.259	0.156	0.719	0.00	0.00
0.65	2.13	8.47	0.452	5.35	0.127	120	21.91	2.74	4.27	93.5	0.259	0.156	0.718	0.00	0.00
0.7	2.30	7.91	0.539	6.83	0.137	120	14.95	2.68	3.83	57.3	0.259	0.097	0.449	0.00	0.00
0.75	2.46	9.16	0.479	5.24	0.147	120	23.70	2.74	4.28	101.3	0.259	0.177	0.814	0.00	0.00
0.8	2.62	8.64	0.387	4.49	0.157	120	22.24	2.72	4.17	92.7	0.259	0.154	0.710	0.00	0.00
0.85	2.79	8.19	0.489	5.99	0.167	120	15.48	2.68	3.85	59.6	0.259	0.100	0.460	0.00	0.00
0.9	2.95	8.39	0.571	6.82	0.176	120	15.86	2.73	4.24	67.2	0.259	0.108	0.499	0.00	0.00
0.95	3.12	9.09	0.625	6.89	0.186	120	17.18	2.73	4.20	72.2	0.259	0.115	0.531	0.00	0.00
1	3.28	9.98	0.745	7.48	0.196	120	18.87	2.74	4.32	81.5	0.259	0.130	0.601	0.00	0.00
1.05	3.44	10.55	0.816	7.75	0.206	120	19.94	2.75	4.40	87.7	0.258	0.143	0.659	0.00	0.00
1.1	3.61	10.31	0.767	7.45	0.212	120	19.49	2.76	4.42	86.1	0.262	0.139	0.633	0.00	0.00
1.15	3.77	10.49	0.692	6.61	0.217	120	19.83	2.72	4.12	81.8	0.268	0.131	0.582	0.00	0.00
1.2	3.94	8.96	0.621	6.94	0.222	120	16.94	2.79	4.67	79.1	0.274	0.126	0.549	0.00	0.00
1.25	4.10	9.17	0.665	7.26	0.226	120	17.33	2.80	4.79	83.1	0.279	0.133	0.569	0.00	0.00
1.3	4.27	9.64	0.681	7.07	0.231	120	18.22	2.78	4.65	84.7	0.285	0.136	0.572	0.00	0.00
1.35	4.43	9.68	0.6	6.21	0.236	120	18.30	2.75	4.35	79.6	0.289	0.127	0.523	0.00	0.00
1.4	4.59	9.21	0.645	7.01	0.241	120	17.41	2.81	4.84	84.3	0.294	0.136	0.550	0.00	0.00
1.45	4.76	8.22	0.585	7.13	0.245	120	15.54	2.85	5.25	81.6	0.299	0.131	0.521	0.00	0.00
1.5	4.92	7.72	0.517	6.71	0.250	120	14.59	2.86	5.31	77.6	0.303	0.123	0.485	0.00	0.00
1.55	5.09	8.87	0.384	4.34	0.255	120	16.77	2.69	3.91	65.6	0.307	0.106	0.412	0.00	0.00
1.6	5.25	34.99	0.313	0.90	0.260	120	66.14	2.01	1.32	87.3	0.311	0.142	0.543	2.40	0.05
1.65	5.41	55.89	0.328	0.59	0.264	115	105.65	1.74	1.07	112.8	0.315	0.214	0.808	1.82	0.04
1.7	5.58	59.22	0.425	0.72	0.268	115	111.17	1.78	1.09	121.3	0.319	0.246	0.919	1.64	0.03
1.75	5.74	58.42	0.471	0.81	0.273	115	108.80	1.82	1.12	121.7	0.323	0.248	0.915	1.66	0.03
1.8	5.91	52.54	0.53	1.01	0.277	115	97.08	1.92	1.20	117.0	0.327	0.229	0.836	1.83	0.04
1.85	6.07	42.83	0.647	1.52	0.281	115	78.53	2.10	1.46	114.4	0.330	0.219	0.793	1.91	0.04
1.9	6.23	33.94	0.466	1.38	0.285	115	61.76	2.15	1.56	96.5	0.333	0.164	0.585	2.30	0.05
1.95	6.40	57.83	0.594	1.03	0.290	115	104.45	1.90	1.19	123.9	0.337	0.257	0.910	1.74	0.03
2	6.56	90.6	0.726	0.80	0.294	115	162.43	1.68	1.03	166.5	0.340	0.509	1.787	1.16	0.00
2.05	6.73	101.99	0.886	0.87	0.298	115	181.52	1.67	1.02	184.6	0.343	0.665	2.314	0.82	0.00
2.1	6.89	100.51	0.946	0.94	0.303	115	177.61	1.70	1.04	184.4	0.346	0.663	2.287	0.82	0.00
2.15	7.05	92.95	0.923	1.00	0.307	115	163.09	1.74	1.07	174.1	0.349	0.570	1.951	1.10	0.00
2.2	7.22	84.75	0.705	0.84	0.311	115	147.67	1.72	1.05	155.6	0.352	0.430	1.459	1.36	0.00
2.25	7.38	75.98	0.68	0.90	0.316	115	131.48	1.78	1.09	143.8	0.354	0.357	1.201	1.44	0.00
2.3	7.55	59.18	0.609	1.03	0.320	115	101.71	1.91	1.20	121.6	0.357	0.247	0.826	1.84	0.04
2.35	7.71	51.78	0.489	0.95	0.324	115	88.40	1.93	1.22	107.8	0.360	0.196	0.652	2.00	0.04
2.4	7.87	41.9	0.521	1.25	0.329	115	71.06	2.08	1.42	100.9	0.362	0.176	0.578	2.00	0.04
2.45	8.04	36.97	0.999	2.71	0.333	115	62.29	2.35	2.11	131.7	0.364	0.293	0.957	1.75	0.03
2.5	8.20	27.62	0.994	3.60	0.337	115	46.24	2.53	2.92	135.1	0.367	0.309	1.006	1.84	0.00
2.55	8.37	33.58	0.95	2.83	0.342	115	55.86	2.40	2.30	128.5	0.369	0.277	0.896	1.91	0.04
2.6	8.53	87.37	0.666	0.77	0.346	115	144.44	1.71	1.04	150.5	0.371	0.397	1.275	1.38	0.00
2.65	8.69	104.67	0.615	0.59	0.350	115	171.97	1.58	1.00	172.0	0.373	0.553	1.766	1.07	0.00
2.7	8.86	108.06	0.63	0.59	0.354	115	176.45	1.56	1.00	176.5	0.376	0.591	1.877	0.98	0.00
2.75	9.02	107.72	0.638	0.59	0.359	115	174.84	1.57	1.00	174.8	0.378	0.577	1.823	1.07	0.00
2.8	9.19	110.06	0.695	0.63	0.363	115	177.57	1.58	1.00	177.6	0.380	0.601	1.887	0.98	0.00
2.85	9.35	110.63	0.769	0.70	0.367	115	177.44	1.61	1.00	177.4	0.382	0.600	1.874	1.00	0.00
2.9	9.51	104.43	0.788	0.76	0.372	115	166.52	1.66	1.01	167.8	0.383	0.519	1.615	1.16	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-1

Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft **Total Estimated Settlement:** 2.38

PGA: 0.40 g Required FS: 1.0

Estimated Earthquake Magnitude: 7.0 Limiting Qc1n-cs for liquefiable soils: 164

Magnitude Scaling Factor: 1.19 Limiting Ic for liquefiable soils: 2.55

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{CIN}	Ic	Kc	$(Q_{CIN})_{CS}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
2.95	9.68	**93.52**	**0.753**	0.81	0.376	115	148.27	1.71	1.05	155.2	0.385	0.427	1.323	1.38	0.00
3	9.84	**78.9**	**0.702**	0.89	0.380	115	124.38	1.80	1.11	137.6	0.387	0.322	0.992	1.53	0.03
3.05	10.01	**64.97**	**0.692**	1.07	0.385	115	101.84	1.92	1.20	122.7	0.389	0.252	0.772	1.84	0.04
3.1	10.17	**47.73**	**0.787**	1.65	0.389	115	74.40	2.15	1.54	114.8	0.391	0.221	0.674	2.00	0.04
3.15	10.33	**28.21**	**0.676**	2.40	0.393	115	43.73	2.43	2.43	106.3	0.392	0.192	0.583	2.30	0.05
3.2	10.50	**20.76**	**0.502**	2.42	0.398	115	32.01	2.54	2.96	94.8	0.394	0.159	0.482	2.40	0.05
3.25	10.66	**16.96**	**0.4**	2.36	0.402	115	40.74	2.54	2.99	121.7	0.396	0.248	0.747	2.00	0.04
3.3	10.83	**14.27**	**0.463**	3.25	0.407	120	26.98	2.60	3.35	90.4	0.397	0.149	0.447	0.00	0.00
3.35	10.99	**13.8**	**0.544**	3.95	0.411	120	26.09	2.68	3.82	99.8	0.398	0.172	0.516	0.00	0.00
3.4	11.15	**14.13**	**0.643**	4.56	0.416	120	26.71	2.71	4.10	109.6	0.400	0.203	0.604	0.00	0.00
3.45	11.32	**14.31**	**0.757**	5.30	0.421	120	27.05	2.76	4.45	120.5	0.401	0.243	0.721	0.00	0.00
3.5	11.48	**14.89**	**0.837**	5.63	0.426	120	28.15	2.77	4.53	127.5	0.402	0.273	0.809	0.00	0.00
3.55	11.65	**16.21**	**0.955**	5.90	0.430	120	30.64	2.76	4.46	136.6	0.404	0.317	0.938	0.00	0.00
3.6	11.81	**38.49**	**0.742**	1.93	0.435	115	56.76	2.28	1.89	107.0	0.405	0.194	0.571	0.00	0.00
3.65	11.98	**96.21**	**0.655**	0.68	0.439	115	141.19	1.68	1.03	144.9	0.406	0.363	1.065	1.48	0.00
3.7	12.14	**106.03**	**0.793**	0.75	0.443	115	154.84	1.68	1.02	158.3	0.408	0.449	1.315	1.33	0.00
3.75	12.30	**109.25**	**0.824**	0.76	0.448	115	158.77	1.67	1.02	161.7	0.409	0.473	1.381	1.25	0.00
3.8	12.47	**115.98**	**0.896**	0.77	0.452	115	167.74	1.66	1.01	169.6	0.410	0.533	1.552	1.18	0.00
3.85	12.63	**117.79**	**0.99**	0.84	0.456	115	169.55	1.68	1.03	173.9	0.411	0.569	1.650	1.11	0.00
3.9	12.80	**114.66**	**1.027**	0.90	0.460	115	164.27	1.71	1.05	171.7	0.412	0.551	1.593	1.18	0.00
3.95	12.96	**102.93**	**1.003**	0.98	0.465	115	146.78	1.77	1.09	159.5	0.414	0.457	1.319	1.26	0.00
4	13.12	**85.75**	**0.99**	1.16	0.469	115	121.72	1.88	1.17	142.7	0.415	0.350	1.007	1.55	0.00
4.05	13.29	**61.04**	**0.952**	1.56	0.473	115	86.25	2.08	1.42	122.7	0.416	0.252	0.722	1.77	0.03
4.1	13.45	**35.71**	**0.744**	2.09	0.478	115	50.23	2.34	2.10	105.2	0.417	0.188	0.539	2.00	0.04
4.15	13.62	**21.47**	**0.484**	2.26	0.482	115	30.06	2.54	2.99	89.9	0.418	0.148	0.421	2.60	0.05
4.2	13.78	**16.23**	**0.331**	2.04	0.486	115	39.40	2.57	3.14	123.7	0.419	0.256	0.728	0.00	0.00
4.25	13.94	**14.36**	**0.363**	2.53	0.491	115	36.26	2.67	3.79	137.6	0.420	0.322	0.915	0.00	0.00
4.3	14.11	**14.95**	**0.494**	3.31	0.495	115	28.26	2.66	3.73	105.3	0.421	0.189	0.534	0.00	0.00
4.35	14.27	**14.95**	**0.652**	4.37	0.499	115	28.26	2.75	4.34	122.5	0.422	0.251	0.710	0.00	0.00
4.4	14.44	**14.91**	**0.727**	4.88	0.504	115	28.19	2.78	4.63	130.6	0.423	0.287	0.809	0.00	0.00
4.45	14.60	**15.84**	**0.781**	4.93	0.508	115	29.94	2.77	4.52	135.3	0.424	0.310	0.873	0.00	0.00
4.5	14.76	**15.99**	**0.775**	4.85	0.512	115	30.23	2.76	4.47	135.2	0.425	0.310	0.870	0.00	0.00
4.55	14.93	**15.73**	**0.823**	5.24	0.517	115	29.74	2.79	4.73	140.7	0.426	0.339	0.950	0.00	0.00
4.6	15.09	**16.17**	**0.859**	5.32	0.521	115	30.57	2.79	4.72	144.2	0.427	0.359	1.003	0.00	0.00
4.65	15.26	**14.83**	**0.853**	5.76	0.525	115	28.03	2.85	5.20	145.8	0.427	0.368	1.028	0.00	0.00
4.7	15.42	**15.43**	**0.906**	5.88	0.530	115	29.14	2.84	5.16	150.5	0.428	0.397	1.105	0.00	0.00
4.75	15.58	**20.71**	**0.813**	3.93	0.534	115	38.80	2.63	3.50	135.8	0.429	0.313	0.870	0.00	0.00
4.8	15.75	**28.87**	**0.631**	2.19	0.538	115	38.26	2.45	2.53	96.7	0.430	0.164	0.456	2.60	0.05
4.85	15.91	**29.96**	**0.672**	2.25	0.542	115	39.55	2.45	2.51	99.3	0.431	0.171	0.473	2.40	0.05
4.9	16.08	**25.23**	**0.624**	2.48	0.547	115	33.17	2.53	2.95	97.7	0.431	0.167	0.461	2.30	0.05
4.95	16.24	**42.18**	**0.582**	1.38	0.551	115	55.24	2.20	1.66	91.7	0.432	0.152	0.419	2.40	0.05
5	16.40	**59.08**	**0.682**	1.16	0.555	115	77.07	2.03	1.35	103.8	0.433	0.184	0.507	2.30	0.05
5.05	16.57	**65.5**	**1.138**	1.74	0.560	115	85.12	2.12	1.49	126.7	0.434	0.269	0.741	1.78	0.04
5.1	16.73	**63.04**	**1.973**	3.13	0.564	115	81.61	2.31	2.00	162.8	0.434	0.482	1.322	1.34	0.00
5.15	16.90	**44.54**	**1.987**	4.46	0.568	115	57.44	2.53	2.94	168.8	0.435	0.527	1.446	1.57	0.00
5.2	17.06	**25.65**	**1.498**	5.84	0.573	115	44.79	2.71	4.03	180.7	0.436	0.629	1.721	0.00	0.00
5.25	17.22	**19.78**	**0.831**	4.21	0.577	115	34.28	2.69	3.92	134.3	0.436	0.305	0.835	0.00	0.00
5.3	17.39	**15.5**	**0.715**	4.62	0.581	115	26.67	2.80	4.80	128.0	0.437	0.275	0.750	0.00	0.00
5.35	17.55	**18.58**	**0.689**	3.71	0.586	115	31.73	2.68	3.84	122.0	0.438	0.249	0.678	0.00	0.00
5.4	17.72	**17.6**	**0.748**	4.25	0.590	115	29.84	2.74	4.29	128.1	0.438	0.275	0.749	0.00	0.00
5.45	17.88	**18.34**	**0.714**	3.90	0.594	115	30.86	2.70	4.01	123.9	0.439	0.257	0.698	0.00	0.00
5.5	18.04	**19.3**	**0.726**	3.77	0.599	115	32.25	2.68	3.83	123.7	0.440	0.256	0.694	0.00	0.00
5.55	18.21	**18.86**	**0.796**	4.22	0.603	115	31.28	2.72	4.15	130.0	0.440	0.284	0.770	0.00	0.00
5.6	18.37	**19.23**	**0.91**	4.74	0.607	115	31.67	2.75	4.39	138.9	0.441	0.329	0.891	0.00	0.00
5.65	18.54	**19.39**	**1.062**	5.48	0.611	115	31.71	2.79	4.74	150.4	0.441	0.396	1.071	0.00	0.00
5.7	18.70	**20.53**	**1.314**	6.40	0.616	115	33.34	2.83	5.02	167.2	0.442	0.515	1.390	0.00	0.00
5.75	18.86	**21.11**	**1.441**	6.83	0.620	115	34.04	2.84	5.14	174.9	0.442	0.577	1.556	0.00	0.00
5.8	19.03	**20.04**	**1.303**	6.51	0.624	115	32.09	2.84	5.17	165.9	0.443	0.505	1.359	0.00	0.00
5.85	19.19	**18.65**	**1.248**	6.70	0.629	115	29.66	2.88	5.49	162.8	0.443	0.481	1.295	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-1

Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft **Total Estimated Settlement:** 2.38

PGA: 0.40 g Required FS: 1.0

Estimated Earthquake Magnitude: 7.0 Limiting Qc1n-cs for liquefiable soils: 164

Magnitude Scaling Factor: 1.19 Limiting Ic for liquefiable soils: 2.55

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{CIN}	Ic	Kc	$(Q_{CIN})_{CS}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
5.9	19.36	**20.33**	**1.268**	6.24	0.633	115	32.11	2.83	5.05	162.3	0.444	0.477	1.282	0.00	0.00
5.95	19.52	**47.91**	**1.309**	2.74	0.637	115	58.34	2.38	2.22	129.3	0.444	0.281	0.754	0.00	0.00
6	19.69	**95.89**	**1.774**	1.85	0.642	115	116.38	2.04	1.36	158.0	0.445	0.447	1.197	1.34	0.00
6.05	19.85	**160.12**	**2.081**	1.30	0.646	115	193.68	1.78	1.09	211.2	0.445	0.956	2.560	0.20	0.00
6.1	20.00	**215.08**	**1.809**	0.84	0.650	115	259.37	1.55	1.00	259.4	0.446	1.703	4.555	0.00	0.00
6.15	20.18	**213.59**	**1.899**	0.89	0.655	115	256.65	1.57	1.00	256.7	0.446	1.652	4.415	0.00	0.00
6.2	20.34	**212.17**	**1.83**	0.86	0.659	115	254.11	1.57	1.00	254.1	0.447	1.606	4.287	0.00	0.00
6.25	20.51	**195.37**	**1.729**	0.89	0.663	115	233.23	1.60	1.00	233.2	0.447	1.260	3.360	0.00	0.00
6.3	20.67	**168.92**	**1.714**	1.02	0.668	115	201.00	1.69	1.03	206.8	0.448	0.903	2.406	0.00	0.00
6.35	20.83	**129.56**	**1.36**	1.05	0.672	115	153.67	1.78	1.09	167.9	0.448	0.520	1.384	1.20	0.00
6.4	21.00	**85.1**	**1.248**	1.47	0.676	115	100.61	2.01	1.32	132.8	0.448	0.298	0.792	0.00	0.00
6.45	21.16	**39.13**	**0.978**	2.50	0.681	115	46.12	2.43	2.42	111.8	0.449	0.210	0.558	0.00	0.00
6.5	21.33	**29.69**	**0.855**	2.88	0.685	115	34.88	2.56	3.10	108.1	0.449	0.197	0.524	0.00	0.00
6.55	21.49	**23.55**	**0.835**	3.55	0.689	115	34.17	2.64	3.59	122.6	0.450	0.251	0.667	0.00	0.00
6.6	21.65	**19.76**	**0.931**	4.71	0.693	115	28.50	2.79	4.67	133.0	0.450	0.299	0.792	0.00	0.00
6.65	21.82	**19.13**	**0.992**	5.19	0.698	115	27.42	2.83	5.02	137.7	0.450	0.323	0.856	0.00	0.00
6.7	21.98	**18.93**	**1.077**	5.69	0.702	115	26.96	2.86	5.33	143.6	0.451	0.355	0.941	0.00	0.00
6.75	22.15	**20.41**	**1.088**	5.33	0.706	115	28.89	2.82	4.94	142.8	0.451	0.351	0.928	0.00	0.00
6.8	22.31	**21.95**	**1.18**	5.38	0.711	115	30.88	2.80	4.77	147.4	0.451	0.378	0.999	0.00	0.00
6.85	22.47	**23.2**	**1.319**	5.69	0.715	115	32.45	2.80	4.78	155.1	0.452	0.427	1.128	0.00	0.00
6.9	22.64	**26.74**	**1.284**	4.81	0.719	115	37.17	2.70	4.02	149.5	0.452	0.391	1.032	0.00	0.00
6.95	22.80	**26.77**	**1.13**	4.22	0.724	115	36.99	2.67	3.76	139.0	0.452	0.330	0.870	0.00	0.00
7	22.97	**27.96**	**0.995**	3.56	0.728	115	38.41	2.60	3.34	128.5	0.452	0.277	0.731	0.00	0.00
7.05	23.13	**27.29**	**1.001**	3.67	0.732	115	37.27	2.62	3.46	129.1	0.453	0.280	0.738	0.00	0.00
7.1	23.29	**29.07**	**1.038**	3.57	0.737	115	72.10	2.62	3.48	250.7	0.453	1.545	4.070	0.00	0.00
7.15	23.46	**31.39**	**1.121**	3.57	0.741	115	77.14	2.60	3.33	256.6	0.453	1.650	4.344	0.00	0.00
7.2	23.62	**32.65**	**1.159**	3.55	0.745	115	79.82	2.59	3.24	259.0	0.453	1.695	4.460	0.00	0.00
7.25	23.79	**32.21**	**1.225**	3.81	0.750	115	79.54	2.61	3.41	270.9	0.454	1.930	5.073	0.00	0.00
7.3	23.95	**31.02**	**1.174**	3.79	0.754	115	76.97	2.63	3.48	268.2	0.454	1.874	4.924	0.00	0.00
7.35	24.11	**28.14**	**0.991**	3.53	0.758	115	37.12	2.61	3.40	126.1	0.454	0.266	0.700	0.00	0.00
7.4	24.28	**25.23**	**0.864**	3.43	0.762	115	33.09	2.64	3.60	119.0	0.454	0.237	0.621	0.00	0.00
7.45	24.44	**28.71**	**1.173**	4.09	0.767	115	37.44	2.65	3.66	137.2	0.454	0.320	0.840	0.00	0.00
7.5	24.61	**29.71**	**1.154**	3.89	0.771	115	38.53	2.63	3.50	134.9	0.455	0.309	0.809	0.00	0.00
7.55	24.77	**24.89**	**0.984**	3.96	0.775	115	32.10	2.69	3.96	127.0	0.455	0.270	0.709	0.00	0.00
7.6	24.93	**21.95**	**1.311**	5.98	0.780	115	28.15	2.86	5.33	150.1	0.455	0.395	1.034	0.00	0.00
7.65	25.10	**41.52**	**1.378**	3.32	0.784	115	45.59	2.51	2.84	129.7	0.455	0.283	0.741	1.84	0.04
7.7	25.26	**69.71**	**1.744**	2.50	0.788	115	76.33	2.27	1.84	140.5	0.455	0.338	0.886	1.50	0.03
7.75	25.43	**40.34**	**1.49**	3.70	0.793	115	44.05	2.56	3.08	135.7	0.455	0.313	0.818	0.00	0.00
7.8	25.59	**23.58**	**1.19**	5.05	0.797	115	29.59	2.79	4.74	140.1	0.456	0.336	0.879	0.00	0.00
7.85	25.75	**24.77**	**1.011**	4.08	0.801	115	30.91	2.72	4.12	127.3	0.456	0.272	0.712	0.00	0.00
7.9	25.92	**20.41**	**1.019**	5.00	0.806	115	25.33	2.84	5.17	131.0	0.456	0.289	0.757	0.00	0.00
7.95	26.08	**19.63**	**0.889**	4.53	0.810	115	24.24	2.83	5.06	122.6	0.456	0.251	0.657	0.00	0.00
8	26.25	**20.42**	**0.856**	4.19	0.814	115	25.08	2.80	4.76	119.4	0.456	0.238	0.623	0.00	0.00
8.05	26.41	**26**	**0.807**	3.11	0.819	115	31.76	2.63	3.51	111.4	0.456	0.209	0.545	0.00	0.00
8.1	26.57	**23.69**	**0.894**	3.78	0.823	115	28.79	2.72	4.13	119.0	0.456	0.237	0.619	0.00	0.00
8.15	26.74	**20**	**0.784**	3.92	0.827	115	24.18	2.79	4.71	113.9	0.456	0.217	0.568	0.00	0.00
8.2	26.90	**17.31**	**0.598**	3.46	0.832	115	20.82	2.81	4.88	101.5	0.456	0.177	0.463	0.00	0.00
8.25	27.07	**15.23**	**0.719**	4.72	0.836	115	18.22	2.95	6.17	112.4	0.456	0.212	0.554	0.00	0.00
8.3	27.23	**22.89**	**0.968**	4.23	0.840	115	27.25	2.77	4.54	123.7	0.457	0.256	0.669	0.00	0.00
8.35	27.40	**43.06**	**1.02**	2.37	0.844	115	45.56	2.42	2.38	108.5	0.457	0.199	0.519	2.15	0.04
8.4	27.56	**53.4**	**1.3**	2.44	0.849	115	56.35	2.35	2.13	120.2	0.457	0.242	0.631	1.84	0.04
8.45	27.72	**48.49**	**1.598**	3.30	0.853	115	51.04	2.48	2.65	135.5	0.457	0.311	0.813	2.00	0.04
8.5	27.89	**57.21**	**1.656**	2.90	0.857	115	60.07	2.39	2.25	135.4	0.457	0.311	0.812	1.78	0.04
8.55	28.05	**82.24**	**1.231**	1.50	0.862	115	86.13	2.07	1.41	121.1	0.457	0.245	0.641	1.78	0.04
8.6	28.22	**65.18**	**1.275**	1.96	0.866	115	68.09	2.23	1.74	118.3	0.457	0.234	0.611	2.15	0.04
8.65	28.38	**44.18**	**1.241**	2.81	0.870	115	46.04	2.46	2.59	119.1	0.457	0.237	0.620	2.15	0.04
8.7	28.54	**29.41**	**1.201**	4.09	0.875	115	33.62	2.69	3.91	131.6	0.457	0.292	0.763	0.00	0.00
8.75	28.71	**27.7**	**1.317**	4.76	0.879	115	31.51	2.76	4.42	139.3	0.457	0.331	0.865	0.00	0.00
8.8	28.87	**35.91**	**1.326**	3.70	0.883	115	88.49	2.61	3.37	298.3	0.457	2.549	6.659	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-1
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft **Total Estimated Settlement:** 2.38
PGA: 0.40 g Required FS: 1.0
Estimated Earthquake Magnitude: 7.0 Limiting Qc1n-cs for liquefiable soils: 164
Magnitude Scaling Factor: 1.19 Limiting Ic for liquefiable soils: 2.55

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{CIN}	Ic	Kc	$(Q_{CIN})_{CS}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
8.85	29.04	**40.18**	**1.425**	3.55	0.888	115	41.46	2.57	3.13	129.7	0.457	0.283	0.740	0.00	0.00
8.9	29.20	**44.45**	**1.296**	2.92	0.892	115	45.76	2.48	2.65	121.3	0.456	0.246	0.642	2.15	0.04
8.95	29.36	**45.45**	**1.146**	2.52	0.896	115	46.67	2.43	2.43	113.2	0.456	0.215	0.562	2.15	0.04
9	29.53	**43.63**	**1.351**	3.10	0.901	115	44.70	2.50	2.78	124.1	0.456	0.258	0.674	2.30	0.05
9.05	29.69	**38.05**	**1.39**	3.66	0.905	115	38.89	2.60	3.31	128.6	0.456	0.278	0.727	0.00	0.00
9.1	29.86	**41**	**1.33**	3.25	0.909	115	41.80	2.54	2.97	124.0	0.456	0.257	0.673	1.91	0.04
9.15	30.02	**34.71**	**1.455**	4.19	0.913	115	38.00	2.66	3.69	140.1	0.456	0.336	0.878	0.00	0.00
9.2	30.18	**38.66**	**1.309**	3.39	0.918	115	39.23	2.57	3.16	123.9	0.456	0.257	0.671	0.00	0.00
9.25	30.35	**41.01**	**1.442**	3.52	0.922	115	41.52	2.56	3.11	129.3	0.456	0.281	0.735	0.00	0.00
9.3	30.51	**40.13**	**1.522**	3.80	0.926	115	40.53	2.59	3.29	133.5	0.456	0.301	0.789	0.00	0.00
9.35	30.68	**44.09**	**1.189**	2.70	0.931	115	44.43	2.46	2.59	115.1	0.456	0.222	0.580	2.30	0.05
9.4	30.84	**50.12**	**1.234**	2.46	0.935	115	50.39	2.39	2.29	115.4	0.456	0.223	0.584	2.00	0.04
9.45	31.00	**27.4**	**0.968**	3.54	0.939	115	29.17	2.70	3.96	115.6	0.455	0.224	0.586	0.00	0.00
9.5	31.17	**18.22**	**0.827**	4.54	0.944	120	19.30	2.91	5.84	112.8	0.455	0.213	0.559	0.00	0.00
9.55	31.33	**28.01**	**0.823**	2.94	0.948	115	29.53	2.64	3.58	105.7	0.455	0.190	0.497	0.00	0.00
9.6	31.50	**27.7**	**0.99**	3.58	0.953	115	29.07	2.70	4.00	116.2	0.455	0.226	0.593	0.00	0.00
9.65	31.66	**32.01**	**1.04**	3.25	0.957	115	33.45	2.62	3.48	116.3	0.455	0.226	0.594	0.00	0.00
9.7	31.82	**32.08**	**1.283**	4.00	0.961	115	33.37	2.69	3.89	129.8	0.454	0.283	0.744	0.00	0.00
9.75	31.99	**31.56**	**1.352**	4.29	0.966	115	32.68	2.71	4.09	133.6	0.454	0.302	0.793	0.00	0.00
9.8	32.15	**30.05**	**1.392**	4.63	0.970	115	30.98	2.75	4.41	136.5	0.454	0.316	0.831	0.00	0.00
9.85	32.32	**28.94**	**1.466**	5.07	0.974	115	29.70	2.79	4.74	140.8	0.454	0.340	0.892	0.00	0.00
9.9	32.48	**29.62**	**1.464**	4.94	0.979	115	30.27	2.78	4.63	140.0	0.454	0.335	0.881	0.00	0.00
9.95	32.64	**30.4**	**1.474**	4.85	0.983	115	30.93	2.77	4.52	139.8	0.453	0.334	0.879	0.00	0.00
10	32.81	**32.47**	**1.175**	3.62	0.987	115	32.89	2.66	3.72	122.4	0.453	0.251	0.660	0.00	0.00
10.05	32.97	**34.31**	**1.456**	4.25	0.992	115	34.60	2.69	3.93	136.0	0.453	0.314	0.826	0.00	0.00
10.1	33.14	**29.01**	**1.452**	5.01	0.996	115	29.13	2.80	4.77	138.8	0.453	0.329	0.866	0.00	0.00
10.15	33.30	**34.49**	**1.585**	4.60	1.001	120	34.47	2.72	4.11	141.8	0.452	0.345	0.910	0.00	0.00
10.2	33.46	**32.61**	**1.638**	5.03	1.005	115	32.45	2.76	4.48	145.3	0.452	0.365	0.963	0.00	0.00
10.25	33.63	**31.94**	**1.566**	4.91	1.010	120	31.64	2.76	4.49	141.9	0.452	0.346	0.913	0.00	0.00
10.3	33.79	**29.06**	**1.546**	5.32	1.014	120	28.65	2.82	4.97	142.4	0.451	0.349	0.921	0.00	0.00
10.35	33.96	**27.29**	**1.51**	5.54	1.019	120	26.78	2.86	5.28	141.5	0.451	0.343	0.908	0.00	0.00
10.4	34.12	**25.3**	**1.339**	5.29	1.024	120	24.71	2.87	5.42	133.9	0.451	0.303	0.802	0.00	0.00
10.45	34.28	**24.07**	**1.126**	4.68	1.029	120	23.40	2.85	5.26	123.1	0.450	0.254	0.672	0.00	0.00
10.5	34.45	**25.1**	**1.245**	4.96	1.033	120	24.29	2.86	5.30	128.7	0.450	0.278	0.737	0.00	0.00
10.55	34.61	**28.05**	**1.492**	5.32	1.038	120	27.02	2.84	5.15	139.1	0.449	0.330	0.877	0.00	0.00
10.6	34.78	**28.11**	**1.528**	5.44	1.043	120	26.96	2.85	5.21	140.6	0.449	0.338	0.899	0.00	0.00
10.65	34.94	**27.04**	**1.608**	5.95	1.047	120	25.82	2.89	5.60	144.7	0.449	0.362	0.962	0.00	0.00
10.7	35.10	**29.46**	**1.429**	4.85	1.052	120	28.00	2.80	4.80	134.5	0.448	0.306	0.814	0.00	0.00
10.75	35.27	**50.16**	**1.39**	2.77	1.057	120	47.44	2.45	2.53	120.0	0.448	0.241	0.641	2.15	0.04
10.8	35.43	**55.23**	**1.272**	2.31	1.061	115	52.12	2.36	2.17	113.4	0.447	0.215	0.574	2.00	0.04
10.85	35.60	**57**	**1.261**	2.21	1.065	115	53.69	2.34	2.10	112.5	0.447	0.212	0.567	1.91	0.04
10.9	35.76	**37.08**	**1.22**	3.29	1.070	115	34.66	2.62	3.42	118.7	0.447	0.235	0.629	0.00	0.00
10.95	35.93	**27.54**	**1.142**	4.15	1.074	115	25.64	2.79	4.68	119.9	0.446	0.240	0.642	0.00	0.00
11	36.09	**24.39**	**1.186**	4.86	1.078	115	22.62	2.88	5.48	123.9	0.446	0.257	0.688	0.00	0.00
11.05	36.25	**24.49**	**1.413**	5.77	1.083	120	22.61	2.93	5.97	135.0	0.445	0.309	0.827	0.00	0.00
11.1	36.42	**24.84**	**1.379**	5.55	1.088	120	22.83	2.91	5.82	132.9	0.445	0.298	0.800	0.00	0.00
11.15	36.58	**32.51**	**1.357**	4.18	1.093	120	29.75	2.74	4.28	127.2	0.444	0.271	0.728	0.00	0.00
11.2	36.75	**36.17**	**1.204**	3.33	1.097	115	32.97	2.64	3.56	117.3	0.444	0.230	0.618	0.00	0.00
11.25	36.91	**26.22**	**0.95**	3.63	1.101	115	23.81	2.78	4.58	109.1	0.444	0.201	0.539	0.00	0.00
11.3	37.07	**19.86**	**0.695**	3.50	1.106	115	17.96	2.87	5.42	97.4	0.443	0.166	0.447	0.00	0.00
11.35	37.24	**16.32**	**0.625**	3.83	1.110	115	14.70	2.97	6.45	94.9	0.443	0.160	0.430	0.00	0.00
11.4	37.40	**17.49**	**0.614**	3.51	1.115	120	15.69	2.92	5.95	93.3	0.442	0.156	0.420	0.00	0.00
11.45	37.57	**19.47**	**0.826**	4.24	1.119	120	17.39	2.94	6.06	105.4	0.442	0.189	0.510	0.00	0.00
11.5	37.73	**22.97**	**1.179**	5.14	1.124	120	20.44	2.93	5.99	122.4	0.441	0.251	0.678	0.00	0.00
11.55	37.89	**73.83**	**1.288**	1.75	1.129	120	67.56	2.20	1.66	112.3	0.441	0.212	0.573	0.00	0.00
11.6	38.06	**221.61**	**1.823**	0.82	1.133	115	202.40	1.62	1.00	202.4	0.440	0.851	2.306	0.00	0.00
11.65	38.22	**300.5**	**2.379**	0.79	1.137	115	273.93	1.52	1.00	273.9	0.440	1.992	5.403	0.00	0.00
11.7	38.39	**356.08**	**2.982**	0.84	1.142	115	323.99	1.49	1.00	324.0	0.439	3.243	8.806	0.00	0.00
11.75	38.55	**381.9**	**3.494**	0.92	1.146	120	346.76	1.50	1.00	346.8	0.439	3.958	10.762	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-1
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft
PGA: 0.40 g
Estimated Earthquake Magnitude: 7.0
Magnitude Scaling Factor: 1.19
Required FS: 1.0
Limiting Qc1n-cs for liquefiable soils: 164
Limiting Ic for liquefiable soils: 2.55
Total Estimated Settlement: 2.38

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{c1N}	Ic	Kc	$(Q_{c1N})_{cs}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
11.8	38.71	**364.75**	**3.497**	0.96	1.151	120	330.51	1.53	1.00	330.5	0.438	3.438	9.360	0.00	0.00
11.85	38.88	**315.61**	**3.328**	1.06	1.156	120	285.40	1.60	1.00	285.4	0.437	2.242	6.112	0.00	0.00
11.9	39.04	**263.11**	**2.786**	1.06	1.161	120	237.44	1.65	1.01	238.6	0.437	1.344	3.668	0.00	0.00
11.95	39.21	**229.44**	**2.331**	1.02	1.165	115	206.67	1.68	1.02	211.7	0.436	0.962	2.629	0.00	0.00
12	39.37	**212.98**	**1.816**	0.85	1.169	115	191.49	1.65	1.00	192.0	0.436	0.738	2.020	0.00	0.00
12.05	39.53	**209.72**	**1.7**	0.81	1.174	115	188.21	1.64	1.00	188.2	0.435	0.700	1.918	0.00	0.00
12.1	39.70	**188.69**	**1.509**	0.80	1.178	115	169.03	1.67	1.02	171.9	0.435	0.553	1.516	0.00	0.00
12.15	39.86	**162.11**	**1.443**	0.89	1.182	115	144.95	1.75	1.07	155.4	0.434	0.429	1.179	1.27	0.00
12.2	40.03	**133.91**	**1.259**	0.94	1.186	115	119.52	1.83	1.13	135.0	0.434	0.309	0.850	1.64	0.03
12.25	40.19	**109.3**	**1.195**	1.10	1.191	115	97.38	1.94	1.23	119.9	0.433	0.240	0.662	1.84	0.04
12.3	40.35	**111.65**	**1.081**	0.97	1.195	115	99.29	1.90	1.19	118.2	0.433	0.234	0.644	1.84	0.04
12.35	40.52	**124.93**	**0.943**	0.76	1.199	115	110.90	1.80	1.10	122.4	0.432	0.251	0.692	1.71	0.03
12.4	40.68	**110.98**	**1.089**	0.98	1.204	115	98.34	1.91	1.20	117.8	0.431	0.232	0.641	1.84	0.04
12.45	40.85	**85.81**	**1.5**	1.75	1.208	115	75.90	2.16	1.58	119.6	0.431	0.239	0.662	1.91	0.04
12.5	41.01	**74.01**	**2.166**	2.93	1.212	115	65.35	2.36	2.17	142.0	0.430	0.346	0.959	1.71	0.03
12.55	41.17	**62.89**	**2.599**	4.13	1.217	115	55.43	2.52	2.89	160.2	0.430	0.463	1.284	1.57	0.00
12.6	41.34	**89.81**	**1.722**	1.92	1.221	120	79.00	2.17	1.61	127.0	0.429	0.271	0.752	1.91	0.04
12.65	41.50	**113.19**	**1.047**	0.93	1.226	115	99.40	1.89	1.18	117.2	0.428	0.230	0.639	1.84	0.04
12.7	41.67	**101.07**	**1.234**	1.22	1.230	115	88.60	2.01	1.31	115.8	0.428	0.225	0.626	2.00	0.04
12.75	41.83	**82.18**	**1.774**	2.16	1.234	115	71.91	2.24	1.77	127.5	0.427	0.273	0.762	2.00	0.04
12.8	41.99	**58.9**	**1.995**	3.39	1.239	115	51.45	2.49	2.70	138.7	0.427	0.328	0.918	2.00	0.04
12.85	42.16	**82.75**	**1.575**	1.91	1.243	115	72.16	2.20	1.67	120.7	0.426	0.243	0.682	2.00	0.04
12.9	42.32	**116.38**	**0.864**	0.74	1.247	115	101.31	1.82	1.12	113.9	0.425	0.218	0.610	1.84	0.04
12.95	42.49	**157.28**	**0.484**	0.31	1.252	115	136.68	1.51	1.00	136.7	0.425	0.317	0.892	1.49	0.03
13	42.65	**184.59**	**0.627**	0.34	1.256	115	160.13	1.47	1.00	160.1	0.424	0.462	1.299	0.00	0.00
13.05	42.81	**186.75**	**0.79**	0.42	1.260	115	161.73	1.51	1.00	161.7	0.423	0.473	1.334	0.00	0.00
13.1	42.98	**196.77**	**1.044**	0.53	1.265	115	170.12	1.55	1.00	170.1	0.423	0.538	1.518	0.00	0.00
13.15	43.14	**208.7**	**1.217**	0.58	1.269	115	180.12	1.56	1.00	180.1	0.422	0.623	1.762	0.00	0.00
13.2	43.31	**221.11**	**0.892**	0.40	1.273	115	190.51	1.44	1.00	190.5	0.421	0.723	2.047	0.00	0.00
13.25	43.47	**245**	**0.968**	0.40	1.278	115	210.74	1.40	1.00	210.7	0.421	0.950	2.695	0.00	0.00
13.3	43.64	**256.2**	**1.198**	0.47	1.282	115	220.00	1.43	1.00	220.0	0.420	1.070	3.039	0.00	0.00
13.35	43.80	**237.02**	**1.084**	0.46	1.286	115	203.19	1.45	1.00	203.2	0.419	0.860	2.447	0.00	0.00
13.4	43.96	**231.72**	**0.941**	0.41	1.290	115	198.31	1.43	1.00	198.3	0.419	0.805	2.294	0.00	0.00
13.45	44.13	**241.34**	**0.865**	0.36	1.295	115	206.20	1.39	1.00	206.2	0.418	0.895	2.555	0.00	0.00
13.5	44.29	**259.12**	**0.979**	0.38	1.299	115	221.02	1.37	1.00	221.0	0.417	1.084	3.099	0.00	0.00
13.55	44.46	**277.68**	**1.144**	0.41	1.303	115	236.46	1.37	1.00	236.5	0.417	1.310	3.750	0.00	0.00
13.6	44.62	**274.34**	**1.167**	0.43	1.308	115	233.23	1.39	1.00	233.2	0.416	1.260	3.613	0.00	0.00
13.65	44.78	**260.81**	**1.032**	0.40	1.312	115	221.37	1.38	1.00	221.4	0.415	1.089	3.128	0.00	0.00
13.7	44.95	**243.64**	**1.042**	0.43	1.316	115	206.45	1.43	1.00	206.5	0.414	0.898	2.585	0.00	0.00
13.75	45.11	**227.25**	**1.176**	0.52	1.321	115	192.25	1.50	1.00	192.3	0.414	0.741	2.136	0.00	0.00
13.8	45.28	**219.7**	**1.37**	0.62	1.325	115	185.56	1.57	1.00	185.6	0.413	0.674	1.947	0.00	0.00
13.85	45.44	**219.13**	**1.508**	0.69	1.329	115	184.78	1.60	1.00	184.8	0.412	0.667	1.929	0.00	0.00
13.9	45.60	**236.49**	**1.737**	0.74	1.334	115	199.09	1.59	1.00	199.1	0.412	0.814	2.358	0.00	0.00
13.95	45.77	**242.43**	**1.687**	0.70	1.338	115	203.77	1.57	1.00	203.8	0.411	0.867	2.516	0.00	0.00
14	45.93	**240.16**	**1.83**	0.76	1.342	115	201.53	1.60	1.00	201.5	0.410	0.841	2.446	0.00	0.00
14.05	46.10	**235.82**	**2.24**	0.95	1.347	115	197.57	1.67	1.02	201.4	0.409	0.839	2.445	0.00	0.00
14.1	46.26	**245.39**	**2.516**	1.03	1.351	115	205.26	1.69	1.03	211.0	0.409	0.953	2.781	0.00	0.00
14.15	46.42	**245.53**	**2.583**	1.05	1.355	115	205.05	1.69	1.03	211.9	0.408	0.965	2.821	0.00	0.00
14.2	46.59	**245.7**	**2.645**	1.08	1.359	115	204.87	1.70	1.04	212.8	0.407	0.976	2.858	0.00	0.00
14.25	46.75	**239.9**	**2.635**	1.10	1.364	115	199.72	1.72	1.05	209.3	0.407	0.933	2.737	0.00	0.00
14.3	46.92	**233.12**	**2.578**	1.11	1.368	115	193.77	1.73	1.06	204.5	0.406	0.876	2.575	0.00	0.00
14.35	47.08	**236.78**	**2.545**	1.08	1.372	115	196.50	1.71	1.05	205.7	0.405	0.889	2.618	0.00	0.00
14.4	47.24	**246.13**	**2.768**	1.13	1.377	115	203.94	1.72	1.05	213.9	0.404	0.991	2.922	0.00	0.00
14.45	47.41	**214.42**	**4.02**	1.88	1.381	115	177.39	1.92	1.21	215.2	0.404	1.007	2.976	0.00	0.00
14.5	47.57	**138.05**	**4.087**	2.96	1.385	115	114.03	2.20	1.67	190.6	0.403	0.724	2.143	1.40	0.00
14.55	47.74	**185.93**	**3.375**	1.82	1.390	115	153.34	1.96	1.25	191.0	0.402	0.728	2.161	0.00	0.00
14.6	47.90	**229.5**	**2.394**	1.04	1.394	115	188.98	1.72	1.05	198.1	0.401	0.803	2.387	0.00	0.00
14.65	48.06	**235.46**	**2.53**	1.08	1.398	115	193.59	1.72	1.05	203.2	0.401	0.860	2.562	0.00	0.00
14.7	48.23	**236.59**	**2.752**	1.16	1.403	115	194.22	1.74	1.07	207.1	0.400	0.906	2.701	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-1

Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft
PGA: 0.40 g
Estimated Earthquake Magnitude: 7.0
Magnitude Scaling Factor: 1.19
Required FS: 1.0
Limiting Qc1n-cs for liquefiable soils: 164
Limiting Ic for liquefiable soils: 2.55
Total Estimated Settlement: 2.38

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{c1N}	Ic	Kc	$(Q_{c1N})_{cs}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
14.75	48.39	**253**	**2.907**	1.15	1.407	115	207.37	1.72	1.05	217.8	0.399	1.041	3.112	0.00	0.00
14.8	48.56	**263.88**	**3.082**	1.17	1.411	115	215.95	1.71	1.05	225.9	0.398	1.152	3.450	0.00	0.00
14.85	48.72	**282.02**	**3.312**	1.18	1.416	115	230.45	1.70	1.03	238.4	0.398	1.341	4.022	0.00	0.00
14.9	48.88	**289.13**	**3.405**	1.18	1.420	115	235.90	1.69	1.03	243.2	0.397	1.417	4.260	0.00	0.00
14.95	49.05	**285**	**3.427**	1.20	1.424	115	232.18	1.70	1.04	241.1	0.396	1.384	4.167	0.00	0.00
15	49.21	**288.3**	**3.388**	1.18	1.429	115	234.51	1.69	1.03	241.9	0.395	1.396	4.213	0.00	0.00
15.05	49.38	**301.49**	**3.476**	1.15	1.433	115	244.87	1.67	1.02	249.5	0.395	1.524	4.607	0.00	0.00
15.1	49.54	**297.63**	**3.516**	1.18	1.437	115	241.37	1.68	1.03	247.9	0.394	1.497	4.535	0.00	0.00
15.15	49.70	**287.85**	**3.538**	1.23	1.441	115	233.09	1.71	1.04	243.0	0.393	1.415	4.295	0.00	0.00
15.2	49.87	**276.48**	**3.152**	1.14	1.446	115	223.55	1.69	1.03	231.1	0.392	1.228	3.736	0.00	0.00
15.25	50.03	**300.24**	**3.522**	1.17	1.450	115	242.40	1.68	1.02	248.4	0.391	1.505	4.586	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-2
Project Name: Centinela Solar Powerline – Calexico, CA

Depth to Water Table: 3.5 ft
PGA: 0.40 g
Estimated Earthquake Magnitude: 7.0
Magnitude Scaling Factor: 1.19
Required FS: 1.0
Limiting Qc1n-cs for liquefiable soils: 164
Limiting Ic for liquefiable soils: 2.55
Total Estimated Settlement: 1.17

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{C1N}	Ic	Kc	$(Q_{C1N})_{CS}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
0	0.00														
0.05	0.16	**30.39**	**0.233**	0.78	0.009	115	57.45	1.48	1.00	57.4	0.260	0.098	0.448	0.00	0.00
0.1	0.33	**25.09**	**0.476**	1.91	0.019	115	47.43	1.93	1.22	57.7	0.260	0.098	0.449	0.00	0.00
0.15	0.49	**20.81**	**0.645**	3.11	0.028	115	39.34	2.20	1.66	65.4	0.260	0.106	0.486	0.00	0.00
0.2	0.66	**16.06**	**0.611**	3.82	0.038	120	30.36	2.38	2.24	67.9	0.260	0.109	0.500	0.00	0.00
0.25	0.82	**13.07**	**0.707**	5.42	0.048	120	24.71	2.59	3.25	80.3	0.260	0.128	0.588	0.00	0.00
0.3	0.98	**10.35**	**0.442**	4.29	0.058	120	23.89	2.44	2.49	59.5	0.260	0.100	0.457	0.00	0.00
0.35	1.15	**9.85**	**0.348**	3.54	0.068	120	18.62	2.59	3.28	61.1	0.260	0.101	0.465	0.00	0.00
0.4	1.31	**8.74**	**0.285**	3.28	0.078	120	20.39	2.47	2.61	53.3	0.260	0.094	0.432	0.00	0.00
0.45	1.48	**9.08**	**0.18**	1.99	0.087	120	17.16	2.50	2.77	47.6	0.260	0.090	0.412	0.00	0.00
0.5	1.64	**9.57**	**0.046**	0.49	0.097	120	18.09	2.18	1.63	29.5	0.260	0.075	0.343	0.00	0.00
0.55	1.80	**22.41**	**0.112**	0.50	0.107	115	42.36	1.88	1.17	49.5	0.259	0.091	0.420	0.00	0.00
0.6	1.97	**27.21**	**0.133**	0.49	0.116	115	51.44	1.82	1.12	57.5	0.259	0.098	0.449	0.00	0.00
0.65	2.13	**28.18**	**0.183**	0.65	0.125	115	53.27	1.88	1.17	62.5	0.259	0.103	0.472	0.00	0.00
0.7	2.30	**16.63**	**0.122**	0.74	0.135	115	31.44	2.12	1.49	46.8	0.259	0.089	0.410	0.00	0.00
0.75	2.46	**12.11**	**0.119**	0.99	0.144	115	22.89	2.32	2.00	45.8	0.259	0.088	0.406	0.00	0.00
0.8	2.62	**10.2**	**0.143**	1.41	0.154	120	19.28	2.47	2.64	51.0	0.259	0.092	0.425	0.00	0.00
0.85	2.79	**10.31**	**0.266**	2.59	0.164	120	24.52	2.52	2.85	69.9	0.259	0.112	0.515	0.00	0.00
0.9	2.95	**9.51**	**0.31**	3.27	0.174	120	23.58	2.62	3.47	81.8	0.259	0.131	0.604	0.00	0.00
0.95	3.12	**10.07**	**0.364**	3.62	0.184	120	25.19	2.65	3.63	91.4	0.259	0.151	0.696	0.00	0.00
1	3.28	**10.9**	**0.453**	4.16	0.194	120	27.55	2.67	3.81	105.0	0.259	0.188	0.866	0.00	0.00
1.05	3.44	**10.97**	**0.472**	4.31	0.203	120	27.93	2.69	3.95	110.4	0.258	0.205	0.946	0.00	0.00
1.1	3.61	**11.51**	**0.465**	4.05	0.210	120	29.01	2.67	3.76	109.1	0.262	0.201	0.912	0.00	0.00
1.15	3.77	**12.68**	**0.587**	4.64	0.215	120	32.14	2.68	3.87	124.3	0.268	0.259	1.149	0.00	0.00
1.2	3.94	**13.15**	**0.676**	5.15	0.219	120	33.66	2.71	4.05	136.4	0.274	0.316	1.375	0.00	0.00
1.25	4.10	**13.02**	**0.626**	4.82	0.224	120	33.17	2.70	3.96	131.4	0.280	0.291	1.240	0.00	0.00
1.3	4.27	**13.61**	**0.636**	4.68	0.229	120	34.44	2.68	3.83	132.0	0.285	0.294	1.231	0.00	0.00
1.35	4.43	**13.93**	**0.624**	4.49	0.233	120	35.04	2.66	3.73	130.6	0.290	0.287	1.181	0.00	0.00
1.4	4.59	**11.37**	**0.605**	5.33	0.238	120	21.49	2.65	3.66	78.8	0.295	0.125	0.508	0.00	0.00
1.45	4.76	**10.11**	**0.496**	4.92	0.243	120	19.11	2.67	3.78	72.2	0.299	0.115	0.458	0.00	0.00
1.5	4.92	**9.6**	**0.46**	4.80	0.248	120	18.15	2.68	3.88	70.5	0.304	0.113	0.442	0.00	0.00
1.55	5.09	**9.42**	**0.498**	5.30	0.252	120	17.81	2.73	4.20	74.7	0.308	0.119	0.460	0.00	0.00
1.6	5.25	**11.29**	**0.405**	3.59	0.257	120	28.67	2.69	3.90	111.8	0.312	0.210	0.803	0.00	0.00
1.65	5.41	**31.27**	**0.287**	0.92	0.262	120	59.11	2.06	1.39	82.2	0.316	0.132	0.497	2.40	0.05
1.7	5.58	**22.78**	**0.293**	1.29	0.266	115	42.93	2.26	1.84	78.9	0.320	0.126	0.469	2.30	0.05
1.75	5.74	**13.61**	**0.308**	2.27	0.270	115	25.44	2.60	3.30	84.0	0.323	0.135	0.498	0.00	0.00
1.8	5.91	**11.98**	**0.299**	2.50	0.275	120	29.24	2.58	3.22	94.1	0.327	0.158	0.575	0.00	0.00
1.85	6.07	**10.69**	**0.327**	3.06	0.280	120	27.10	2.68	3.87	104.7	0.330	0.187	0.675	0.00	0.00
1.9	6.23	**11.46**	**0.351**	3.07	0.285	120	28.84	2.66	3.73	107.6	0.334	0.196	0.700	0.00	0.00
1.95	6.40	**11.32**	**0.391**	3.46	0.289	120	28.93	2.70	4.03	116.5	0.337	0.227	0.804	0.00	0.00
2	6.56	**10.93**	**0.454**	4.16	0.294	120	20.66	2.66	3.69	76.1	0.340	0.121	0.425	0.00	0.00
2.05	6.73	**12.7**	**0.323**	2.55	0.299	120	31.06	2.59	3.25	101.0	0.343	0.176	0.612	0.00	0.00
2.1	6.89	**66.4**	**0.292**	0.44	0.304	120	117.17	1.64	1.00	117.2	0.346	0.230	0.792	0.00	0.00
2.15	7.05	**93.3**	**0.399**	0.43	0.308	115	163.48	1.51	1.00	163.5	0.349	0.486	1.664	1.10	0.00
2.2	7.22	**95.07**	**0.49**	0.52	0.312	115	165.43	1.55	1.00	165.4	0.351	0.501	1.701	1.12	0.00
2.25	7.38	**81.64**	**0.533**	0.66	0.316	115	141.09	1.67	1.02	143.6	0.354	0.356	1.198	1.44	0.00
2.3	7.55	**61.77**	**0.628**	1.02	0.321	115	106.03	1.89	1.18	125.0	0.357	0.262	0.875	1.75	0.03
2.35	7.71	**41.33**	**0.647**	1.57	0.325	115	70.47	2.15	1.55	109.0	0.359	0.201	0.666	2.00	0.04
2.4	7.87	**42.3**	**0.775**	1.84	0.329	115	71.65	2.19	1.64	117.3	0.362	0.230	0.759	2.00	0.04
2.45	8.04	**48.31**	**0.987**	2.05	0.334	115	81.30	2.18	1.62	131.7	0.364	0.292	0.958	1.84	0.04
2.5	8.20	**47.79**	**1.216**	2.55	0.338	115	79.91	2.25	1.81	144.5	0.367	0.360	1.173	1.91	0.00
2.55	8.37	**48.62**	**1.045**	2.15	0.342	115	80.79	2.20	1.66	134.2	0.369	0.305	0.986	1.84	0.04
2.6	8.53	**96.47**	**0.864**	0.90	0.347	115	159.29	1.72	1.05	167.5	0.371	0.517	1.662	1.23	0.00
2.65	8.69	**110.04**	**0.768**	0.70	0.351	115	180.58	1.61	1.00	180.6	0.373	0.628	2.006	0.98	0.00
2.7	8.86	**106.73**	**0.828**	0.78	0.355	115	174.08	1.65	1.00	174.6	0.375	0.575	1.827	1.07	0.00
2.75	9.02	**98.93**	**0.834**	0.85	0.360	115	160.39	1.70	1.04	166.5	0.377	0.509	1.610	1.23	0.00
2.8	9.19	**92.14**	**0.854**	0.93	0.364	115	148.49	1.75	1.07	159.4	0.379	0.457	1.436	1.23	0.00
2.85	9.35	**83.27**	**0.826**	1.00	0.368	115	133.41	1.81	1.11	148.4	0.381	0.384	1.200	1.38	0.00
2.9	9.51	**69.84**	**0.754**	1.08	0.373	115	111.24	1.89	1.18	131.3	0.383	0.291	0.905	1.69	0.03

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-2
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft
PGA: 0.40 g
Estimated Earthquake Magnitude: 7.0
Magnitude Scaling Factor: 1.19
Required FS: 1.0
Limiting Qc1n-cs for liquefiable soils: 164
Limiting Ic for liquefiable soils: 2.55
Total Estimated Settlement: 1.17

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{c1N}	Ic	Kc	$(Q_{c1N})_{cs}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
2.95	9.68	**54.93**	**0.641**	1.17	0.377	115	86.99	1.99	1.29	112.5	0.385	0.212	0.658	2.00	0.04
3	9.84	**43.23**	**0.57**	1.32	0.381	115	68.07	2.11	1.48	100.5	0.387	0.174	0.538	2.15	0.04
3.05	10.01	**33.2**	**0.625**	1.89	0.385	115	51.99	2.30	1.95	101.6	0.389	0.178	0.545	2.00	0.04
3.1	10.17	**19.91**	**0.655**	3.29	0.390	115	48.42	2.57	3.17	153.3	0.390	0.415	1.269	0.00	0.00
3.15	10.33	**14.64**	**0.561**	3.84	0.395	120	27.67	2.63	3.54	98.0	0.392	0.167	0.510	0.00	0.00
3.2	10.50	**11.65**	**0.51**	4.38	0.399	120	22.02	2.75	4.40	97.0	0.393	0.165	0.500	0.00	0.00
3.25	10.66	**11.22**	**0.383**	3.42	0.404	120	21.21	2.70	3.99	84.6	0.395	0.136	0.412	0.00	0.00
3.3	10.83	**11.72**	**0.408**	3.49	0.409	120	22.16	2.69	3.95	87.5	0.396	0.142	0.428	0.00	0.00
3.35	10.99	**12.74**	**0.409**	3.22	0.413	120	24.08	2.65	3.62	87.1	0.398	0.142	0.424	0.00	0.00
3.4	11.15	**12.85**	**0.427**	3.33	0.418	120	24.29	2.66	3.69	89.6	0.399	0.147	0.439	0.00	0.00
3.45	11.32	**13.04**	**0.452**	3.47	0.423	120	24.65	2.67	3.76	92.8	0.400	0.154	0.460	0.00	0.00
3.5	11.48	**12.61**	**0.445**	3.53	0.428	120	23.84	2.69	3.91	93.2	0.402	0.155	0.461	0.00	0.00
3.55	11.65	**12.44**	**0.413**	3.33	0.432	120	23.52	2.68	3.85	90.5	0.403	0.149	0.441	0.00	0.00
3.6	11.81	**12.66**	**0.393**	3.11	0.437	120	23.93	2.66	3.70	88.6	0.404	0.145	0.427	0.00	0.00
3.65	11.98	**13.65**	**0.466**	3.42	0.442	120	25.80	2.66	3.73	96.3	0.405	0.163	0.480	0.00	0.00
3.7	12.14	**13.59**	**0.531**	3.91	0.446	115	25.69	2.71	4.04	103.8	0.407	0.184	0.540	0.00	0.00
3.75	12.30	**14.06**	**0.572**	4.07	0.450	115	26.58	2.71	4.07	108.1	0.408	0.198	0.578	0.00	0.00
3.8	12.47	**14.35**	**0.599**	4.18	0.455	115	27.13	2.71	4.10	111.1	0.409	0.208	0.606	0.00	0.00
3.85	12.63	**15.75**	**0.683**	4.34	0.459	115	29.77	2.70	3.98	118.4	0.410	0.234	0.681	0.00	0.00
3.9	12.80	**16.38**	**0.767**	4.69	0.463	115	30.96	2.71	4.07	126.1	0.411	0.267	0.773	0.00	0.00
3.95	12.96	**18.3**	**0.797**	4.36	0.468	115	34.59	2.66	3.69	127.5	0.413	0.273	0.788	0.00	0.00
4	13.12	**19.7**	**0.784**	3.99	0.472	115	37.24	2.61	3.37	125.6	0.414	0.264	0.762	0.00	0.00
4.05	13.29	**16.34**	**0.772**	4.73	0.476	115	30.89	2.72	4.17	128.7	0.415	0.278	0.801	0.00	0.00
4.1	13.45	**13.24**	**0.785**	5.93	0.481	115	25.03	2.86	5.36	134.0	0.416	0.304	0.872	0.00	0.00
4.15	13.62	**12.53**	**0.68**	5.43	0.485	115	23.69	2.86	5.31	125.8	0.417	0.265	0.758	0.00	0.00
4.2	13.78	**14.62**	**0.603**	4.13	0.489	115	27.64	2.73	4.21	116.4	0.418	0.227	0.647	0.00	0.00
4.25	13.94	**15.77**	**0.645**	4.10	0.494	115	29.81	2.70	4.03	120.0	0.419	0.241	0.685	0.00	0.00
4.3	14.11	**14.67**	**0.67**	4.57	0.498	115	27.73	2.76	4.49	124.4	0.420	0.259	0.735	0.00	0.00
4.35	14.27	**15.3**	**0.652**	4.27	0.502	115	28.92	2.73	4.24	122.5	0.421	0.251	0.711	0.00	0.00
4.4	14.44	**15.3**	**0.646**	4.23	0.506	115	28.92	2.73	4.24	122.6	0.422	0.251	0.710	0.00	0.00
4.45	14.60	**15.38**	**0.715**	4.65	0.511	115	29.07	2.76	4.47	130.0	0.423	0.284	0.801	0.00	0.00
4.5	14.76	**14.4**	**0.755**	5.25	0.515	115	27.22	2.82	4.98	135.6	0.424	0.312	0.877	0.00	0.00
4.55	14.93	**12.19**	**0.661**	5.43	0.519	115	23.04	2.89	5.62	129.6	0.425	0.282	0.793	0.00	0.00
4.6	15.09	**11.48**	**0.389**	3.39	0.524	115	21.70	2.78	4.65	100.8	0.426	0.175	0.491	0.00	0.00
4.65	15.26	**10.2**	**0.344**	3.38	0.528	115	19.28	2.83	5.04	97.1	0.426	0.165	0.462	0.00	0.00
4.7	15.42	**12.88**	**0.373**	2.90	0.532	115	24.19	2.70	4.03	97.5	0.427	0.166	0.464	0.00	0.00
4.75	15.58	**11.27**	**0.335**	2.98	0.537	115	21.00	2.76	4.49	94.2	0.428	0.158	0.440	0.00	0.00
4.8	15.75	**8.56**	**0.196**	2.29	0.541	115	15.82	2.81	4.85	76.7	0.429	0.122	0.339	0.00	0.00
4.85	15.91	**9.45**	**0.138**	1.46	0.545	115	17.33	2.66	3.75	64.9	0.430	0.105	0.293	0.00	0.00
4.9	16.08	**10.83**	**0.181**	1.68	0.550	115	19.70	2.64	3.61	71.1	0.431	0.113	0.314	0.00	0.00
4.95	16.24	**11.49**	**0.2**	1.74	0.554	115	20.74	2.63	3.54	73.4	0.431	0.117	0.323	0.00	0.00
5	16.40	**12.27**	**0.241**	1.97	0.558	115	21.98	2.64	3.58	78.8	0.432	0.125	0.346	0.00	0.00
5.05	16.57	**14.02**	**0.28**	2.00	0.563	115	35.22	2.66	3.70	130.3	0.433	0.286	0.788	0.00	0.00
5.1	16.73	**12.75**	**0.321**	2.52	0.567	115	22.49	2.70	3.96	89.1	0.434	0.146	0.401	0.00	0.00
5.15	16.90	**12.4**	**0.319**	2.58	0.571	115	21.71	2.71	4.10	89.0	0.434	0.146	0.400	0.00	0.00
5.2	17.06	**14.84**	**0.348**	2.35	0.576	115	25.79	2.63	3.49	89.9	0.435	0.148	0.405	0.00	0.00
5.25	17.22	**17.34**	**0.49**	2.83	0.580	115	29.90	2.62	3.47	103.6	0.436	0.184	0.503	0.00	0.00
5.3	17.39	**20.33**	**0.703**	3.46	0.584	115	34.80	2.63	3.50	121.6	0.436	0.247	0.676	0.00	0.00
5.35	17.55	**21.13**	**0.774**	3.67	0.588	115	35.91	2.63	3.54	127.0	0.437	0.270	0.738	0.00	0.00
5.4	17.72	**19.12**	**0.849**	4.44	0.593	115	32.25	2.73	4.19	135.1	0.437	0.309	0.844	0.00	0.00
5.45	17.88	**18.67**	**0.741**	3.97	0.597	115	31.27	2.70	4.02	125.8	0.438	0.265	0.721	0.00	0.00
5.5	18.04	**18.5**	**0.789**	4.27	0.601	115	30.76	2.73	4.22	129.8	0.439	0.284	0.771	0.00	0.00
5.55	18.21	**20.05**	**0.922**	4.60	0.606	115	33.10	2.73	4.20	139.2	0.439	0.331	0.898	0.00	0.00
5.6	18.37	**20.54**	**1.076**	5.24	0.610	115	33.67	2.76	4.47	150.4	0.440	0.397	1.076	0.00	0.00
5.65	18.54	**20.19**	**1.054**	5.22	0.614	115	32.86	2.77	4.52	148.7	0.440	0.386	1.044	0.00	0.00
5.7	18.70	**19.99**	**1.026**	5.14	0.619	115	32.31	2.77	4.53	146.3	0.441	0.371	1.004	0.00	0.00
5.75	18.86	**18.02**	**0.999**	5.55	0.623	115	28.93	2.83	5.04	145.7	0.442	0.368	0.993	0.00	0.00
5.8	19.03	**19.07**	**0.872**	4.58	0.627	115	30.40	2.75	4.41	134.2	0.442	0.305	0.822	0.00	0.00
5.85	19.19	**17.89**	**0.609**	3.41	0.632	115	28.32	2.69	3.95	111.9	0.443	0.210	0.567	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-2
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: **3.5 ft** **Total Estimated Settlement:** **1.17**
PGA: **0.40 g** Required FS: **1.0**
Estimated Earthquake Magnitude: **7.0** Limiting Qc1n-cs for liquefiable soils: **164**
Magnitude Scaling Factor: **1.19** Limiting Ic for liquefiable soils: **2.55**

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{c1N}	Ic	Kc	$(Q_{c1N})_{cs}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
5.9	19.36	**15.55**	**0.869**	5.59	0.636	115	24.45	2.89	5.58	136.6	0.443	0.317	0.853	0.00	0.00
5.95	19.52	**21.53**	**0.911**	4.24	0.640	115	33.63	2.70	3.98	133.9	0.444	0.303	0.816	0.00	0.00
6	19.69	**28.65**	**1.005**	3.51	0.645	115	70.18	2.59	3.28	229.9	0.444	1.209	3.248	0.00	0.00
6.05	19.85	**23.11**	**1.187**	5.14	0.649	115	35.62	2.74	4.28	152.4	0.445	0.409	1.098	0.00	0.00
6.1	20.00	**24.19**	**1.299**	5.37	0.653	115	37.05	2.74	4.29	158.8	0.445	0.453	1.213	0.00	0.00
6.15	20.18	**24.74**	**1.343**	5.43	0.657	115	37.63	2.74	4.27	160.8	0.445	0.467	1.250	0.00	0.00
6.2	20.34	**25.55**	**1.091**	4.27	0.662	115	38.61	2.66	3.68	142.2	0.446	0.347	0.929	0.00	0.00
6.25	20.51	**36.38**	**0.84**	2.31	0.666	115	43.34	2.42	2.41	104.7	0.446	0.187	0.499	2.30	0.05
6.3	20.67	**24.85**	**0.441**	1.78	0.670	115	29.51	2.49	2.72	80.2	0.447	0.128	0.341	2.90	0.06
6.35	20.83	**17.38**	**0.419**	2.41	0.675	115	25.76	2.63	3.54	91.3	0.447	0.151	0.402	0.00	0.00
6.4	21.00	**13.86**	**0.285**	2.06	0.679	115	20.41	2.68	3.87	78.9	0.448	0.126	0.335	0.00	0.00
6.45	21.16	**12.77**	**0.389**	3.05	0.683	115	18.69	2.82	4.93	92.1	0.448	0.153	0.406	0.00	0.00
6.5	21.33	**14.01**	**0.475**	3.39	0.688	115	20.37	2.81	4.89	99.7	0.448	0.172	0.458	0.00	0.00
6.55	21.49	**17.98**	**0.532**	2.96	0.692	115	25.98	2.69	3.90	101.3	0.449	0.177	0.469	0.00	0.00
6.6	21.65	**21.59**	**0.66**	3.06	0.696	115	31.01	2.63	3.53	109.4	0.449	0.202	0.536	0.00	0.00
6.65	21.82	**20.6**	**0.765**	3.72	0.701	115	29.40	2.71	4.04	118.8	0.449	0.236	0.626	0.00	0.00
6.7	21.98	**21.64**	**0.828**	3.83	0.705	115	30.70	2.70	3.99	122.6	0.450	0.252	0.667	0.00	0.00
6.75	22.15	**22.18**	**1.02**	4.60	0.709	115	31.27	2.75	4.36	136.2	0.450	0.315	0.835	0.00	0.00
6.8	22.31	**23.34**	**1.27**	5.44	0.714	115	32.71	2.78	4.64	151.9	0.450	0.406	1.075	0.00	0.00
6.85	22.47	**24.8**	**1.376**	5.55	0.718	115	34.55	2.77	4.55	157.1	0.451	0.441	1.166	0.00	0.00
6.9	22.64	**23.41**	**1.183**	5.06	0.722	115	32.41	2.76	4.49	145.4	0.451	0.366	0.968	0.00	0.00
6.95	22.80	**23.44**	**0.909**	3.88	0.727	115	32.26	2.69	3.90	125.9	0.451	0.265	0.702	0.00	0.00
7	22.97	**23.4**	**0.817**	3.50	0.731	115	32.02	2.66	3.71	118.7	0.452	0.236	0.622	0.00	0.00
7.05	23.13	**24.55**	**0.837**	3.41	0.735	115	33.39	2.64	3.57	119.1	0.452	0.237	0.626	0.00	0.00
7.1	23.29	**27.4**	**0.846**	3.09	0.739	115	67.41	2.60	3.35	225.5	0.452	1.147	3.026	0.00	0.00
7.15	23.46	**26.15**	**0.869**	3.33	0.744	115	35.16	2.61	3.41	119.7	0.452	0.240	0.632	0.00	0.00
7.2	23.62	**25.59**	**0.844**	3.30	0.748	115	34.21	2.62	3.45	118.1	0.453	0.233	0.614	0.00	0.00
7.25	23.79	**25.95**	**1.02**	3.93	0.752	115	34.49	2.67	3.77	130.1	0.453	0.285	0.750	0.00	0.00
7.3	23.95	**27.96**	**1.047**	3.75	0.757	115	36.95	2.63	3.52	130.1	0.453	0.285	0.750	0.00	0.00
7.35	24.11	**23.78**	**0.855**	3.60	0.761	115	31.25	2.68	3.83	119.5	0.453	0.239	0.628	0.00	0.00
7.4	24.28	**22.12**	**0.858**	3.88	0.765	115	28.90	2.72	4.18	120.8	0.453	0.244	0.642	0.00	0.00
7.45	24.44	**22.82**	**0.898**	3.94	0.770	115	29.65	2.72	4.15	122.9	0.454	0.253	0.664	0.00	0.00
7.5	24.61	**21.56**	**0.855**	3.97	0.774	115	27.86	2.74	4.33	120.6	0.454	0.243	0.639	0.00	0.00
7.55	24.77	**17.09**	**0.645**	3.78	0.778	115	21.96	2.81	4.91	107.9	0.454	0.197	0.517	0.00	0.00
7.6	24.93	**16.29**	**0.535**	3.29	0.783	115	20.81	2.80	4.76	99.0	0.454	0.170	0.447	0.00	0.00
7.65	25.10	**17.48**	**0.624**	3.57	0.787	115	22.21	2.80	4.75	105.4	0.454	0.189	0.496	0.00	0.00
7.7	25.26	**21.34**	**0.912**	4.28	0.791	115	26.97	2.78	4.59	123.9	0.455	0.257	0.674	0.00	0.00
7.75	25.43	**23.23**	**0.981**	4.23	0.796	115	29.20	2.75	4.34	126.9	0.455	0.270	0.708	0.00	0.00
7.8	25.59	**22.38**	**0.791**	3.54	0.800	115	27.98	2.71	4.07	113.8	0.455	0.217	0.569	0.00	0.00
7.85	25.75	**17.38**	**0.471**	2.71	0.804	115	21.61	2.73	4.23	91.5	0.455	0.151	0.396	0.00	0.00
7.9	25.92	**17.41**	**0.331**	1.90	0.808	115	21.53	2.64	3.60	77.5	0.455	0.123	0.323	0.00	0.00
7.95	26.08	**17.13**	**0.393**	2.30	0.813	115	21.08	2.70	3.98	84.0	0.455	0.135	0.354	0.00	0.00
8	26.25	**20.49**	**0.674**	3.29	0.817	115	25.08	2.73	4.21	105.6	0.455	0.190	0.497	0.00	0.00
8.05	26.41	**26.15**	**0.858**	3.28	0.821	115	31.83	2.64	3.60	114.8	0.455	0.221	0.578	0.00	0.00
8.1	26.57	**24.91**	**0.93**	3.74	0.826	115	30.17	2.70	3.99	120.4	0.456	0.242	0.635	0.00	0.00
8.15	26.74	**20.36**	**0.621**	3.05	0.830	115	24.53	2.72	4.12	101.0	0.456	0.176	0.460	0.00	0.00
8.2	26.90	**16.99**	**0.487**	2.87	0.834	115	20.36	2.77	4.53	92.2	0.456	0.153	0.400	0.00	0.00
8.25	27.07	**16.41**	**0.436**	2.66	0.839	115	19.57	2.76	4.49	87.9	0.456	0.143	0.375	0.00	0.00
8.3	27.23	**20.6**	**0.488**	2.37	0.843	115	24.44	2.65	3.65	89.2	0.456	0.146	0.382	0.00	0.00
8.35	27.40	**16.18**	**0.349**	2.16	0.847	115	19.10	2.72	4.16	79.4	0.456	0.126	0.331	0.00	0.00
8.4	27.56	**16.06**	**0.271**	1.69	0.852	115	18.86	2.67	3.76	71.0	0.456	0.113	0.296	0.00	0.00
8.45	27.72	**12.72**	**0.231**	1.82	0.856	115	14.86	2.78	4.64	68.9	0.456	0.110	0.289	0.00	0.00
8.5	27.89	**12.09**	**0.219**	1.81	0.860	115	14.05	2.81	4.83	67.9	0.456	0.109	0.286	0.00	0.00
8.55	28.05	**11.98**	**0.308**	2.57	0.865	115	13.86	2.89	5.65	78.3	0.456	0.125	0.326	0.00	0.00
8.6	28.22	**14.54**	**0.431**	2.97	0.869	115	16.73	2.85	5.26	88.1	0.456	0.144	0.376	0.00	0.00
8.65	28.38	**15.9**	**0.407**	2.56	0.873	115	18.21	2.78	4.65	84.6	0.456	0.136	0.357	0.00	0.00
8.7	28.54	**13.99**	**0.442**	3.16	0.878	115	15.94	2.89	5.60	89.3	0.456	0.146	0.382	0.00	0.00
8.75	28.71	**19.45**	**0.914**	4.70	0.882	115	22.06	2.88	5.46	120.5	0.456	0.243	0.635	0.00	0.00
8.8	28.87	**35.31**	**0.731**	2.07	0.886	115	36.47	2.46	2.56	93.3	0.456	0.156	0.407	2.60	0.05

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-2

Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft

PGA: 0.40 g

Estimated Earthquake Magnitude: 7.0

Magnitude Scaling Factor: 1.19

Required FS: 1.0

Limiting Qc1n-cs for liquefiable soils: 164

Limiting Ic for liquefiable soils: 2.55

Total Estimated Settlement: 1.17

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{CIN}	Ic	Kc	$(Q_{CIN})_{CS}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
8.85	29.04	**73.78**	**0.795**	1.08	0.890	115	76.01	2.02	1.33	101.1	0.456	0.176	0.461	2.30	0.05
8.9	29.20	**81.66**	**1.154**	1.42	0.895	115	83.93	2.06	1.39	116.9	0.456	0.229	0.598	1.84	0.04
8.95	29.36	**90.23**	**1.388**	1.54	0.899	115	92.51	2.06	1.38	127.8	0.456	0.274	0.718	1.71	0.03
9	29.53	**101.27**	**1.745**	1.73	0.903	115	103.58	2.06	1.38	142.9	0.456	0.351	0.920	1.57	0.03
9.05	29.69	**113.57**	**1.881**	1.66	0.908	115	115.89	2.01	1.31	152.0	0.456	0.406	1.064	1.64	0.00
9.1	29.86	**127.76**	**1.817**	1.42	0.912	115	130.06	1.93	1.21	157.9	0.456	0.446	1.168	1.50	0.00
9.15	30.02	**129.45**	**1.456**	1.13	0.916	115	131.47	1.85	1.15	150.7	0.455	0.398	1.042	1.50	0.00
9.2	30.18	**77.87**	**1.909**	2.45	0.921	115	78.90	2.25	1.80	141.7	0.455	0.345	0.903	1.91	0.04
9.25	30.35	**45.79**	**1.653**	3.61	0.925	115	46.29	2.54	2.96	137.0	0.455	0.319	0.837	1.84	0.04
9.3	30.51	**30.24**	**1.096**	3.63	0.929	115	32.54	2.66	3.75	122.0	0.455	0.249	0.652	0.00	0.00
9.35	30.68	**31.5**	**0.953**	3.03	0.934	115	33.74	2.60	3.33	112.4	0.455	0.212	0.556	0.00	0.00
9.4	30.84	**31.3**	**0.952**	3.04	0.938	115	33.37	2.61	3.36	112.3	0.455	0.212	0.555	0.00	0.00
9.45	31.00	**28.71**	**1.047**	3.65	0.942	115	30.47	2.69	3.92	119.5	0.455	0.239	0.626	0.00	0.00
9.5	31.17	**26.19**	**1.037**	3.96	0.947	115	27.67	2.75	4.35	120.3	0.455	0.242	0.635	0.00	0.00
9.55	31.33	**24.84**	**1.064**	4.29	0.951	115	26.12	2.79	4.70	122.7	0.454	0.252	0.661	0.00	0.00
9.6	31.50	**26.59**	**1.034**	3.89	0.955	115	27.84	2.74	4.29	119.5	0.454	0.239	0.627	0.00	0.00
9.65	31.66	**29.66**	**1.122**	3.79	0.959	115	30.91	2.70	3.96	122.4	0.454	0.251	0.659	0.00	0.00
9.7	31.82	**33.6**	**1.156**	3.44	0.964	115	34.86	2.63	3.49	121.7	0.454	0.248	0.651	0.00	0.00
9.75	31.99	**33.37**	**1.192**	3.57	0.968	115	34.47	2.64	3.59	123.7	0.454	0.256	0.673	0.00	0.00
9.8	32.15	**33.62**	**1.225**	3.65	0.972	115	34.57	2.65	3.62	125.2	0.454	0.262	0.690	0.00	0.00
9.85	32.32	**34.13**	**1.304**	3.82	0.977	115	34.94	2.66	3.69	128.9	0.453	0.279	0.735	0.00	0.00
9.9	32.48	**33.83**	**1.33**	3.93	0.981	115	34.48	2.67	3.78	130.3	0.453	0.286	0.752	0.00	0.00
9.95	32.64	**35.31**	**1.425**	4.04	0.985	115	35.83	2.66	3.74	134.1	0.453	0.304	0.801	0.00	0.00
10	32.81	**38.07**	**1.357**	3.57	0.990	115	38.47	2.60	3.35	128.8	0.453	0.279	0.735	0.00	0.00
10.05	32.97	**32.23**	**1.32**	4.10	0.994	115	32.42	2.70	4.01	130.1	0.452	0.285	0.750	0.00	0.00
10.1	33.14	**27.24**	**1.274**	4.68	0.998	115	27.29	2.80	4.79	130.6	0.452	0.287	0.757	0.00	0.00
10.15	33.30	**24.54**	**1.228**	5.01	1.003	115	24.48	2.86	5.29	129.6	0.452	0.282	0.745	0.00	0.00
10.2	33.46	**22.56**	**1.085**	4.81	1.007	120	22.40	2.88	5.48	122.7	0.452	0.252	0.666	0.00	0.00
10.25	33.63	**20.24**	**0.89**	4.40	1.012	120	20.00	2.89	5.63	112.6	0.451	0.213	0.562	0.00	0.00
10.3	33.79	**23.9**	**1.097**	4.59	1.016	115	23.51	2.85	5.20	122.2	0.451	0.250	0.660	0.00	0.00
10.35	33.96	**28.88**	**1.582**	5.48	1.021	115	28.29	2.83	5.09	143.9	0.451	0.357	0.945	0.00	0.00
10.4	34.12	**46.65**	**1.46**	3.13	1.025	120	44.79	2.51	2.80	125.2	0.450	0.263	0.695	0.00	0.00
10.45	34.28	**170.71**	**1.129**	0.66	1.030	115	163.55	1.63	1.00	163.5	0.450	0.487	1.290	0.00	0.00
10.5	34.45	**184.91**	**1.351**	0.73	1.034	115	176.78	1.63	1.00	176.8	0.450	0.594	1.575	0.00	0.00
10.55	34.61	**152.42**	**1.577**	1.04	1.038	115	145.42	1.79	1.10	160.3	0.449	0.463	1.229	1.27	0.00
10.6	34.78	**100.95**	**1.773**	1.76	1.043	115	96.11	2.09	1.43	137.3	0.449	0.321	0.852	0.00	0.00
10.65	34.94	**62.14**	**1.723**	2.78	1.047	115	59.04	2.38	2.23	131.6	0.449	0.292	0.776	0.00	0.00
10.7	35.10	**38.32**	**1.582**	4.13	1.051	115	36.45	2.67	3.75	136.7	0.448	0.318	0.845	0.00	0.00
10.75	35.27	**26.46**	**1.11**	4.20	1.056	115	25.07	2.80	4.77	119.6	0.448	0.239	0.636	0.00	0.00
10.8	35.43	**27.27**	**1.033**	3.79	1.060	115	25.73	2.76	4.46	114.6	0.448	0.220	0.586	0.00	0.00
10.85	35.60	**26.02**	**0.951**	3.66	1.064	115	24.45	2.77	4.52	110.6	0.447	0.206	0.548	0.00	0.00
10.9	35.76	**24.79**	**0.845**	3.41	1.069	115	23.20	2.77	4.52	104.9	0.447	0.187	0.500	0.00	0.00
10.95	35.93	**21.59**	**0.955**	4.43	1.073	115	20.12	2.89	5.63	113.2	0.447	0.215	0.574	0.00	0.00
11	36.09	**25.19**	**1.217**	4.83	1.077	115	23.38	2.86	5.35	125.1	0.446	0.262	0.701	0.00	0.00
11.05	36.25	**27.2**	**1.444**	5.31	1.082	120	25.14	2.87	5.37	135.0	0.446	0.309	0.827	0.00	0.00
11.1	36.42	**29.16**	**1.093**	3.75	1.087	120	26.83	2.74	4.31	115.8	0.445	0.224	0.601	0.00	0.00
11.15	36.58	**27.32**	**1.086**	3.98	1.091	115	25.04	2.78	4.65	116.3	0.445	0.226	0.607	0.00	0.00
11.2	36.75	**22.1**	**1.068**	4.84	1.095	115	20.18	2.92	5.86	118.3	0.444	0.234	0.628	0.00	0.00
11.25	36.91	**23.11**	**1.045**	4.52	1.100	120	21.01	2.88	5.54	116.3	0.444	0.226	0.608	0.00	0.00
11.3	37.07	**28.54**	**1.079**	3.78	1.104	115	25.84	2.76	4.44	114.7	0.443	0.220	0.593	0.00	0.00
11.35	37.24	**27.12**	**0.96**	3.54	1.109	115	24.46	2.76	4.45	108.8	0.443	0.200	0.538	0.00	0.00
11.4	37.40	**21.6**	**0.741**	3.43	1.113	115	19.41	2.84	5.10	99.1	0.443	0.170	0.459	0.00	0.00
11.45	37.57	**20.96**	**0.775**	3.70	1.117	115	18.76	2.87	5.41	101.4	0.442	0.177	0.478	0.00	0.00
11.5	37.73	**29.26**	**0.894**	3.06	1.122	115	26.09	2.70	3.96	103.4	0.442	0.183	0.494	0.00	0.00
11.55	37.89	**146.78**	**1.171**	0.80	1.126	115	134.49	1.74	1.07	143.6	0.441	0.356	0.962	1.42	0.03
11.6	38.06	**204.76**	**1.521**	0.74	1.130	115	187.25	1.61	1.00	187.3	0.441	0.691	1.869	0.00	0.00
11.65	38.22	**240.59**	**1.105**	0.46	1.135	115	219.60	1.43	1.00	219.6	0.440	1.065	2.885	0.00	0.00
11.7	38.39	**238.66**	**1.378**	0.58	1.139	115	217.42	1.49	1.00	217.4	0.440	1.036	2.810	0.00	0.00
11.75	38.55	**189.06**	**1.696**	0.90	1.143	115	171.91	1.70	1.04	178.2	0.439	0.606	1.647	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-2
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft
PGA: 0.40 g
Estimated Earthquake Magnitude: 7.0
Magnitude Scaling Factor: 1.19
Required FS: 1.0
Limiting Qc1n-cs for liquefiable soils: 164
Limiting Ic for liquefiable soils: 2.55
Total Estimated Settlement: 1.17

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{CIN}	Ic	Kc	$(Q_{CIN})_{CS}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
11.8	38.71	**123.51**	**1.915**	1.55	1.147	115	112.10	2.00	1.30	145.6	0.439	0.367	0.998	1.71	0.03
11.85	38.88	**62.66**	**1.941**	3.10	1.152	115	56.76	2.43	2.42	137.5	0.438	0.322	0.875	0.00	0.00
11.9	39.04	**41.52**	**1.382**	3.33	1.156	115	35.91	2.61	3.37	121.0	0.438	0.245	0.667	0.00	0.00
11.95	39.21	**25.81**	**1.018**	3.95	1.160	115	22.24	2.82	4.99	111.1	0.437	0.207	0.566	0.00	0.00
12	39.37	**35.78**	**1.076**	3.01	1.165	115	30.72	2.63	3.53	108.5	0.437	0.199	0.543	0.00	0.00
12.05	39.53	**49.73**	**1.246**	2.51	1.169	115	44.72	2.44	2.49	111.4	0.436	0.209	0.571	2.30	0.05
12.1	39.70	**131.66**	**1.103**	0.84	1.173	115	118.17	1.80	1.11	131.0	0.436	0.289	0.791	1.64	0.03
12.15	39.86	**133.83**	**1.269**	0.95	1.178	115	119.89	1.83	1.13	135.6	0.435	0.312	0.855	1.64	0.03
12.2	40.03	**87.53**	**1.349**	1.54	1.182	115	78.27	2.11	1.48	115.8	0.434	0.225	0.616	1.91	0.04
12.25	40.19	**60.96**	**1.193**	1.96	1.186	115	54.41	2.30	1.96	106.8	0.434	0.193	0.531	1.91	0.04
12.3	40.35	**33.64**	**0.994**	2.96	1.191	115	28.25	2.66	3.70	104.5	0.433	0.186	0.512	0.00	0.00
12.35	40.52	**20.8**	**0.696**	3.35	1.195	115	17.41	2.87	5.43	94.5	0.433	0.159	0.437	0.00	0.00
12.4	40.68	**20.51**	**0.546**	2.66	1.199	115	17.10	2.82	4.96	84.8	0.432	0.137	0.377	0.00	0.00
12.45	40.85	**20.69**	**0.469**	2.27	1.204	115	17.19	2.78	4.60	79.0	0.432	0.126	0.348	0.00	0.00
12.5	41.01	**18.39**	**0.597**	3.25	1.208	115	15.23	2.92	5.87	89.3	0.431	0.146	0.405	0.00	0.00
12.55	41.17	**21.28**	**1.043**	4.90	1.212	115	17.56	2.97	6.44	113.1	0.430	0.215	0.595	0.00	0.00
12.6	41.34	**62.98**	**0.757**	1.20	1.217	120	55.50	2.16	1.58	87.9	0.430	0.143	0.398	2.40	0.05
12.65	41.50	**119.73**	**0.626**	0.52	1.221	115	105.33	1.72	1.05	110.9	0.429	0.207	0.575	1.84	0.04
12.7	41.67	**152.92**	**0.623**	0.41	1.226	115	134.29	1.57	1.00	134.3	0.429	0.305	0.850	1.57	0.03
12.75	41.83	**185.25**	**0.631**	0.34	1.230	115	162.40	1.46	1.00	162.4	0.428	0.478	1.333	0.00	0.00
12.8	41.99	**213.2**	**0.711**	0.33	1.234	115	186.58	1.41	1.00	186.6	0.427	0.684	1.909	0.00	0.00
12.85	42.16	**232.29**	**0.853**	0.37	1.238	115	202.93	1.40	1.00	202.9	0.427	0.857	2.396	0.00	0.00
12.9	42.32	**246.78**	**1.016**	0.41	1.243	115	215.21	1.40	1.00	215.2	0.426	1.007	2.819	0.00	0.00
12.95	42.49	**248.65**	**1.364**	0.55	1.247	115	216.47	1.48	1.00	216.5	0.425	1.023	2.869	0.00	0.00
13	42.65	**240.84**	**1.337**	0.56	1.251	115	209.31	1.49	1.00	209.3	0.425	0.933	2.620	0.00	0.00
13.05	42.81	**238.99**	**1.246**	0.52	1.256	115	207.34	1.48	1.00	207.3	0.424	0.909	2.557	0.00	0.00
13.1	42.98	**232.51**	**1.07**	0.46	1.260	115	201.37	1.46	1.00	201.4	0.423	0.839	2.365	0.00	0.00
13.15	43.14	**227.76**	**1.028**	0.45	1.264	115	196.92	1.46	1.00	196.9	0.423	0.790	2.229	0.00	0.00
13.2	43.31	**220.1**	**0.927**	0.42	1.269	115	189.98	1.45	1.00	190.0	0.422	0.718	2.028	0.00	0.00
13.25	43.47	**213.7**	**0.854**	0.40	1.273	115	184.14	1.45	1.00	184.1	0.421	0.661	1.870	0.00	0.00
13.3	43.64	**227.61**	**0.747**	0.33	1.277	115	195.79	1.38	1.00	195.8	0.421	0.778	2.206	0.00	0.00
13.35	43.80	**216.18**	**0.922**	0.43	1.282	115	185.65	1.47	1.00	185.6	0.420	0.675	1.917	0.00	0.00
13.4	43.96	**185.8**	**1.023**	0.55	1.286	115	159.29	1.59	1.00	159.3	0.419	0.456	1.297	0.00	0.00
13.45	44.13	**181.79**	**1.194**	0.66	1.290	115	155.59	1.64	1.00	155.2	0.419	0.428	1.218	0.00	0.00
13.5	44.29	**188.1**	**1.467**	0.78	1.295	115	160.73	1.68	1.02	164.5	0.418	0.494	1.411	0.00	0.00
13.55	44.46	**202.78**	**1.738**	0.86	1.299	115	172.98	1.68	1.03	177.5	0.417	0.600	1.716	0.00	0.00
13.6	44.62	**226.05**	**2.127**	0.94	1.303	115	192.51	1.68	1.02	196.9	0.417	0.790	2.261	0.00	0.00
13.65	44.78	**246.46**	**2.503**	1.02	1.308	115	209.55	1.68	1.02	214.0	0.416	0.992	2.844	0.00	0.00
13.7	44.95	**258.96**	**2.931**	1.13	1.312	115	219.81	1.70	1.04	227.6	0.415	1.177	3.381	0.00	0.00
13.75	45.11	**270.71**	**3.248**	1.20	1.316	115	229.41	1.70	1.04	238.6	0.414	1.344	3.867	0.00	0.00
13.8	45.28	**275.5**	**3.453**	1.25	1.320	115	233.09	1.71	1.05	244.0	0.414	1.432	4.127	0.00	0.00
13.85	45.44	**290.25**	**3.702**	1.28	1.325	115	245.17	1.71	1.04	255.3	0.413	1.628	4.702	0.00	0.00
13.9	45.60	**298.05**	**3.884**	1.30	1.329	115	251.35	1.71	1.04	261.9	0.412	1.750	5.062	0.00	0.00
13.95	45.77	**299.73**	**3.968**	1.33	1.333	115	252.35	1.71	1.04	263.6	0.412	1.784	5.170	0.00	0.00
14	45.93	**301.86**	**4.144**	1.37	1.338	115	253.74	1.72	1.05	266.9	0.411	1.849	5.368	0.00	0.00
14.05	46.10	**302.97**	**4.209**	1.39	1.342	115	254.26	1.72	1.05	268.1	0.410	1.872	5.444	0.00	0.00
14.1	46.26	**299.2**	**4.286**	1.43	1.346	115	250.69	1.74	1.06	266.8	0.409	1.845	5.376	0.00	0.00
14.15	46.42	**292.21**	**4.311**	1.48	1.351	115	244.44	1.76	1.08	262.9	0.409	1.770	5.166	0.00	0.00
14.2	46.59	**286.18**	**4.081**	1.43	1.355	115	239.02	1.75	1.07	256.2	0.408	1.643	4.805	0.00	0.00
14.25	46.75	**284.1**	**4.271**	1.50	1.359	115	236.90	1.77	1.09	257.2	0.407	1.663	4.871	0.00	0.00
14.3	46.92	**282.14**	**4.093**	1.45	1.364	115	234.90	1.76	1.08	253.4	0.406	1.594	4.678	0.00	0.00
14.35	47.08	**227.34**	**4.043**	1.78	1.368	115	188.97	1.89	1.18	222.8	0.406	1.109	3.260	0.00	0.00
14.4	47.24	**261.25**	4	1.53	1.372	115	216.82	1.80	1.11	240.1	0.405	1.367	4.027	0.00	0.00
14.45	47.41	**260.93**	**3.95**	1.52	1.377	115	216.22	1.80	1.11	239.0	0.404	1.349	3.980	0.00	0.00
14.5	47.57	**267.05**	**3.806**	1.43	1.381	115	220.94	1.77	1.09	240.0	0.403	1.366	4.039	0.00	0.00
14.55	47.74	**276.07**	**3.933**	1.43	1.385	115	228.05	1.76	1.08	246.4	0.403	1.471	4.356	0.00	0.00
14.6	47.90	**284.47**	**4.164**	1.47	1.389	115	234.62	1.76	1.08	253.7	0.402	1.599	4.743	0.00	0.00
14.65	48.06	**299.55**	**4.322**	1.44	1.394	115	246.68	1.75	1.07	263.6	0.401	1.784	5.303	0.00	0.00
14.7	48.23	**314.15**	**4.518**	1.44	1.398	115	258.30	1.73	1.06	273.7	0.400	1.987	5.918	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-2
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table:	3.5 ft			**Total Estimated Settlement:**	**1.17**
PGA:	0.40 g	Required FS:	**1.0**		
Estimated Earthquake Magnitude:	7.0	Limiting Qc1n-cs for liquefiable soils:	**164**		
Magnitude Scaling Factor:	1.19	Limiting Ic for liquefiable soils:	**2.55**		

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{c1N}	Ic	Kc	$(Q_{c1N})_{cs}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
14.75	48.39	**336.8**	**4.846**	1.44	1.402	115	276.50	1.71	1.05	289.7	0.400	2.341	6.985	0.00	0.00
14.8	48.56	**337.87**	**4.797**	1.42	1.407	115	276.95	1.71	1.04	289.2	0.399	2.330	6.965	0.00	0.00
14.85	48.72	**299.95**	**4.36**	1.45	1.411	115	245.49	1.75	1.07	263.0	0.398	1.772	5.307	0.00	0.00
14.9	48.88	**260.39**	**3.682**	1.42	1.415	115	212.79	1.78	1.09	232.4	0.397	1.247	3.742	0.00	0.00
14.95	49.05	**259.37**	**3.152**	1.22	1.420	115	211.63	1.73	1.06	224.1	0.397	1.126	3.386	0.00	0.00
15	49.21	**276.48**	**3.152**	1.14	1.424	115	225.25	1.69	1.03	232.6	0.396	1.250	3.765	0.00	0.00
15.05	49.38	**300.24**	**3.522**	1.17	1.428	115	244.24	1.68	1.02	249.9	0.395	1.532	4.623	0.00	0.00
15.1	49.54	**312.44**	**2.985**	0.96	1.433	115	253.78	1.60	1.00	253.8	0.394	1.600	4.839	0.00	0.00
15.15	49.70	**319.81**	**4.687**	1.47	1.437	115	259.38	1.74	1.06	275.8	0.394	2.031	6.155	0.00	0.00
15.2	49.87	**233.31**	**5.199**	2.23	1.441	115	188.94	1.97	1.26	237.9	0.393	1.332	4.043	0.00	0.00
15.25	50.03	**320.47**	**5.485**	1.71	1.446	115	259.13	1.79	1.10	285.3	0.392	2.240	6.814	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-3
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft
PGA: 0.40 g
Estimated Earthquake Magnitude: 7.0
Magnitude Scaling Factor: 1.19
Required FS: 1.0
Limiting Qc1n-cs for liquefiable soils: 164
Limiting Ic for liquefiable soils: 2.55
Total Estimated Settlement: 2.13

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{CIN}	Ic	Kc	$(Q_{CIN})_{CS}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
0	0.00														
0.05	0.16	25.98	0.061	0.24	0.009	115	49.11	1.20	1.00	49.1	0.260	0.091	0.417	0.00	0.00
0.1	0.33	50.24	0.275	0.55	0.019	115	94.97	1.32	1.00	95.0	0.260	0.160	0.732	0.00	0.00
0.15	0.49	39.87	0.634	1.60	0.028	115	75.37	1.80	1.10	83.2	0.260	0.134	0.613	0.00	0.00
0.2	0.66	29.6	0.848	2.88	0.038	115	55.95	2.12	1.48	83.1	0.260	0.133	0.611	0.00	0.00
0.25	0.82	21.62	0.61	2.83	0.047	115	40.87	2.23	1.74	71.1	0.260	0.113	0.520	0.00	0.00
0.3	0.98	14.81	0.181	1.23	0.057	120	28.00	2.13	1.51	42.3	0.260	0.085	0.391	0.00	0.00
0.35	1.15	11.12	0.013	0.12	0.067	120	21.02	1.86	1.16	24.3	0.260	0.070	0.322	0.00	0.00
0.4	1.31	8.41	0.018	0.22	0.077	120	15.90	2.07	1.40	22.3	0.260	0.069	0.315	0.00	0.00
0.45	1.48	7.97	0.367	4.62	0.087	120	19.78	2.63	3.49	69.1	0.260	0.111	0.508	0.00	0.00
0.5	1.64	7.7	0.343	4.47	0.096	120	19.29	2.65	3.65	70.4	0.260	0.112	0.517	0.00	0.00
0.55	1.80	20.39	0.408	2.01	0.106	115	38.54	2.26	1.84	70.8	0.259	0.113	0.520	0.00	0.00
0.6	1.97	14.54	0.407	2.81	0.116	120	27.49	2.49	2.70	74.1	0.259	0.118	0.542	0.00	0.00
0.65	2.13	12.16	0.281	2.32	0.125	120	22.99	2.50	2.79	64.2	0.259	0.105	0.481	0.00	0.00
0.7	2.30	9.96	0.032	0.32	0.135	120	18.83	2.17	1.60	30.1	0.259	0.075	0.345	0.00	0.00
0.75	2.46	9	0.082	0.92	0.145	120	17.01	2.41	2.37	40.3	0.259	0.084	0.385	0.00	0.00
0.8	2.62	9.61	0.107	1.12	0.155	120	18.17	2.44	2.50	45.5	0.259	0.088	0.405	0.00	0.00
0.85	2.79	9.95	0.097	0.98	0.165	120	18.81	2.41	2.37	44.6	0.259	0.087	0.402	0.00	0.00
0.9	2.95	9.94	0.233	2.35	0.175	120	23.65	2.52	2.86	67.5	0.259	0.109	0.501	0.00	0.00
0.95	3.12	10.98	0.415	3.79	0.185	120	27.32	2.63	3.53	96.6	0.259	0.164	0.755	0.00	0.00
1	3.28	11.85	0.434	3.67	0.194	120	29.24	2.61	3.39	99.3	0.259	0.171	0.789	0.00	0.00
1.05	3.44	11.69	0.414	3.55	0.204	120	28.91	2.62	3.43	99.1	0.258	0.171	0.788	0.00	0.00
1.1	3.61	11.83	0.375	3.18	0.211	120	28.93	2.59	3.25	94.1	0.262	0.158	0.716	0.00	0.00
1.15	3.77	12.77	0.443	3.48	0.215	120	31.31	2.59	3.29	103.1	0.268	0.182	0.808	0.00	0.00
1.2	3.94	14.67	0.495	3.38	0.220	120	35.31	2.55	3.01	106.4	0.274	0.192	0.836	0.00	0.00
1.25	4.10	16.48	0.451	2.74	0.225	120	31.15	2.55	3.03	94.3	0.280	0.158	0.674	0.00	0.00
1.3	4.27	16.34	0.51	3.13	0.230	120	30.89	2.59	3.28	101.3	0.285	0.177	0.741	0.00	0.00
1.35	4.43	11.2	0.471	4.21	0.234	120	28.72	2.71	4.09	117.6	0.290	0.231	0.952	0.00	0.00
1.4	4.59	12.16	0.416	3.43	0.239	120	30.24	2.63	3.52	106.5	0.294	0.192	0.778	0.00	0.00
1.45	4.76	12.21	0.498	4.09	0.244	120	30.99	2.69	3.89	120.6	0.299	0.243	0.970	0.00	0.00
1.5	4.92	13.18	0.635	4.82	0.248	120	33.83	2.72	4.11	139.0	0.303	0.330	1.296	0.00	0.00
1.55	5.09	13.66	0.62	4.55	0.253	120	34.73	2.69	3.93	136.4	0.308	0.316	1.224	0.00	0.00
1.6	5.25	14.32	0.669	4.68	0.258	120	36.39	2.69	3.91	142.3	0.312	0.348	1.332	0.00	0.00
1.65	5.41	14.92	0.699	4.69	0.263	120	37.80	2.68	3.86	145.7	0.316	0.368	1.390	0.00	0.00
1.7	5.58	14.76	0.815	5.53	0.267	120	27.90	2.62	3.46	96.6	0.319	0.164	0.612	0.00	0.00
1.75	5.74	14.44	0.818	5.67	0.272	120	27.30	2.64	3.59	98.0	0.323	0.168	0.619	0.00	0.00
1.8	5.91	13.65	0.76	5.58	0.277	120	25.80	2.66	3.70	95.5	0.327	0.161	0.588	0.00	0.00
1.85	6.07	13.27	0.543	4.10	0.282	120	33.78	2.69	3.95	133.4	0.330	0.301	1.087	0.00	0.00
1.9	6.23	10.38	0.448	4.32	0.286	120	19.62	2.67	3.82	74.9	0.333	0.119	0.426	0.00	0.00
1.95	6.40	11.15	0.493	4.43	0.291	120	21.08	2.66	3.75	78.9	0.336	0.126	0.446	0.00	0.00
2	6.56	12.01	0.67	5.59	0.296	120	22.70	2.72	4.13	93.8	0.339	0.157	0.550	0.00	0.00
2.05	6.73	13	0.646	4.98	0.300	120	24.57	2.66	3.73	91.7	0.342	0.152	0.528	0.00	0.00
2.1	6.89	14.63	0.56	3.83	0.305	120	36.79	2.66	3.72	136.9	0.345	0.319	1.101	0.00	0.00
2.15	7.05	12.83	0.482	3.76	0.310	120	32.77	2.70	4.02	131.6	0.348	0.292	1.001	0.00	0.00
2.2	7.22	12.85	0.45	3.51	0.315	120	32.62	2.69	3.89	127.0	0.351	0.271	0.920	0.00	0.00
2.25	7.38	13.29	0.485	3.65	0.319	120	33.79	2.69	3.92	132.5	0.353	0.297	1.001	0.00	0.00
2.3	7.55	14.02	0.623	4.45	0.324	120	26.50	2.63	3.50	92.8	0.356	0.154	0.518	0.00	0.00
2.35	7.71	14.02	0.668	4.77	0.329	120	26.50	2.65	3.68	97.4	0.358	0.166	0.553	0.00	0.00
2.4	7.87	15.43	0.672	4.36	0.334	120	29.17	2.60	3.33	97.2	0.360	0.165	0.547	0.00	0.00
2.45	8.04	47	0.503	1.07	0.338	115	78.62	2.00	1.31	102.7	0.363	0.181	0.594	0.00	0.00
2.5	8.20	108.04	0.473	0.44	0.342	115	179.57	1.48	1.00	179.6	0.365	0.619	2.020	0.94	0.00
2.55	8.37	125.42	0.74	0.59	0.346	115	207.16	1.51	1.00	207.2	0.367	0.907	2.943	0.17	0.00
2.6	8.53	124.74	0.869	0.70	0.351	115	204.76	1.57	1.00	204.8	0.370	0.878	2.834	0.17	0.00
2.65	8.69	118.32	0.951	0.81	0.355	115	193.04	1.63	1.00	193.0	0.372	0.749	2.403	0.61	0.00
2.7	8.86	109.15	0.964	0.89	0.359	115	177.01	1.68	1.03	181.6	0.374	0.637	2.032	0.98	0.00
2.75	9.02	100.51	0.928	0.93	0.364	115	162.03	1.72	1.05	170.8	0.376	0.543	1.723	1.23	0.00
2.8	9.19	82.41	0.851	1.04	0.368	115	132.07	1.82	1.12	148.4	0.378	0.384	1.211	1.38	0.00
2.85	9.35	64.82	0.764	1.18	0.372	115	103.28	1.94	1.23	127.0	0.380	0.271	0.849	1.76	0.03
2.9	9.51	47.95	0.645	1.35	0.377	115	75.96	2.08	1.42	107.8	0.382	0.197	0.614	1.91	0.04

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-3
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft
PGA: 0.40 g
Estimated Earthquake Magnitude: 7.0
Magnitude Scaling Factor: 1.19
Required FS: 1.0
Limiting Qc1n-cs for liquefiable soils: 164
Limiting Ic for liquefiable soils: 2.55
Total Estimated Settlement: 2.13

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{c1N}	Ic	Kc	$(Q_{c1N})_{cs}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
2.95	9.68	**36.73**	**0.637**	1.74	0.381	115	57.85	2.24	1.78	102.9	0.384	0.181	0.563	2.40	0.05
3	9.84	**21.87**	**0.56**	2.56	0.385	115	34.25	2.53	2.92	100.0	0.385	0.173	0.536	2.30	0.05
3.05	10.01	**16.04**	**0.41**	2.56	0.390	120	39.04	2.58	3.18	124.1	0.387	0.258	0.794	0.00	0.00
3.1	10.17	**13.46**	**0.345**	2.57	0.395	120	33.60	2.64	3.59	120.5	0.389	0.243	0.745	0.00	0.00
3.15	10.33	**11.87**	**0.487**	4.11	0.399	120	22.44	2.73	4.21	94.4	0.390	0.158	0.483	0.00	0.00
3.2	10.50	**12.24**	**0.549**	4.49	0.404	120	23.14	2.75	4.36	100.9	0.392	0.175	0.534	0.00	0.00
3.25	10.66	**13.81**	**0.647**	4.69	0.409	120	26.11	2.72	4.18	109.2	0.393	0.201	0.610	0.00	0.00
3.3	10.83	**16.16**	**0.712**	4.41	0.414	120	30.55	2.66	3.71	113.3	0.395	0.215	0.651	0.00	0.00
3.35	10.99	**14.96**	**0.71**	4.75	0.418	120	28.28	2.71	4.07	115.1	0.396	0.222	0.669	0.00	0.00
3.4	11.15	**13.89**	**0.588**	4.24	0.423	120	26.26	2.70	4.03	105.7	0.397	0.190	0.570	0.00	0.00
3.45	11.32	**13.51**	**0.459**	3.40	0.428	120	25.54	2.65	3.67	93.7	0.399	0.157	0.468	0.00	0.00
3.5	11.48	**12.68**	**0.439**	3.47	0.433	120	23.97	2.68	3.88	93.1	0.400	0.155	0.462	0.00	0.00
3.55	11.65	**12.29**	**0.467**	3.80	0.437	120	23.23	2.73	4.19	97.3	0.401	0.166	0.492	0.00	0.00
3.6	11.81	**13.01**	**0.559**	4.30	0.442	120	24.59	2.75	4.34	106.7	0.402	0.193	0.572	0.00	0.00
3.65	11.98	**13.66**	**0.602**	4.41	0.447	120	25.82	2.74	4.30	111.0	0.404	0.207	0.612	0.00	0.00
3.7	12.14	**14.13**	**0.639**	4.53	0.451	115	26.71	2.74	4.29	114.7	0.405	0.220	0.649	0.00	0.00
3.75	12.30	**15.67**	**0.693**	4.43	0.455	115	29.62	2.70	4.01	118.8	0.406	0.236	0.693	0.00	0.00
3.8	12.47	**22.63**	**0.63**	2.79	0.460	115	32.45	2.57	3.16	102.6	0.407	0.181	0.529	0.00	0.00
3.85	12.63	**39.3**	**0.551**	1.41	0.464	115	56.09	2.20	1.66	92.9	0.409	0.154	0.451	2.40	0.05
3.9	12.80	**29.89**	**0.557**	1.87	0.468	115	42.47	2.37	2.19	93.0	0.410	0.155	0.451	2.30	0.05
3.95	12.96	**17.87**	**0.46**	2.58	0.473	115	43.71	2.59	3.25	142.2	0.411	0.348	1.009	0.00	0.00
4	13.12	**14.69**	**0.345**	2.35	0.477	115	36.60	2.64	3.56	130.1	0.412	0.285	0.825	0.00	0.00
4.05	13.29	**14.9**	**0.324**	2.18	0.481	115	36.80	2.61	3.41	125.5	0.413	0.264	0.761	0.00	0.00
4.1	13.45	**16.43**	**0.5**	3.05	0.486	115	41.47	2.67	3.79	157.0	0.414	0.440	1.267	0.00	0.00
4.15	13.62	**17.72**	**0.732**	4.14	0.490	115	33.50	2.67	3.75	125.7	0.415	0.265	0.760	0.00	0.00
4.2	13.78	**17.75**	**0.845**	4.77	0.494	115	33.55	2.71	4.07	136.7	0.416	0.317	0.909	0.00	0.00
4.25	13.94	**16.13**	**0.875**	5.43	0.498	115	30.49	2.78	4.65	141.9	0.417	0.346	0.987	0.00	0.00
4.3	14.11	**13.66**	**0.765**	5.61	0.503	115	25.82	2.85	5.24	135.3	0.418	0.311	0.885	0.00	0.00
4.35	14.27	**16.44**	**0.755**	4.60	0.507	115	31.08	2.73	4.25	132.0	0.419	0.294	0.836	0.00	0.00
4.4	14.44	**16.47**	**0.85**	5.17	0.511	115	31.13	2.77	4.54	141.4	0.420	0.343	0.973	0.00	0.00
4.45	14.60	**17.82**	**0.984**	5.53	0.516	115	33.69	2.77	4.52	152.4	0.421	0.409	1.158	0.00	0.00
4.5	14.76	**18.47**	**0.92**	4.99	0.520	115	34.91	2.73	4.21	146.9	0.422	0.375	1.058	0.00	0.00
4.55	14.93	**14.01**	**0.702**	5.01	0.524	115	26.48	2.82	5.00	132.3	0.423	0.296	0.833	0.00	0.00
4.6	15.09	**11.84**	**0.537**	4.54	0.529	115	22.38	2.86	5.29	118.4	0.424	0.234	0.659	0.00	0.00
4.65	15.26	**12.06**	**0.402**	3.34	0.533	115	22.63	2.77	4.51	102.1	0.425	0.179	0.503	0.00	0.00
4.7	15.42	**11.03**	**0.355**	3.22	0.537	115	20.53	2.79	4.73	97.1	0.426	0.165	0.463	0.00	0.00
4.75	15.58	**10.23**	**0.373**	3.65	0.542	115	18.89	2.86	5.30	100.2	0.427	0.173	0.485	0.00	0.00
4.8	15.75	**13.72**	**0.61**	4.45	0.546	115	25.13	2.81	4.88	122.6	0.427	0.251	0.702	0.00	0.00
4.85	15.91	**18.9**	**1.045**	5.53	0.550	115	34.35	2.77	4.55	156.1	0.428	0.434	1.209	0.00	0.00
4.9	16.08	**21.08**	**1.236**	5.87	0.555	115	38.01	2.76	4.43	168.5	0.429	0.525	1.459	0.00	0.00
4.95	16.24	**20.78**	**1.257**	6.05	0.559	115	37.18	2.77	4.57	169.8	0.430	0.535	1.486	0.00	0.00
5	16.40	**18.17**	**1.001**	5.51	0.563	115	32.26	2.79	4.70	151.8	0.430	0.405	1.123	0.00	0.00
5.05	16.57	**13.24**	**0.719**	5.44	0.568	115	23.33	2.90	5.65	131.9	0.431	0.293	0.811	0.00	0.00
5.1	16.73	**11.13**	**0.486**	4.37	0.572	115	19.46	2.90	5.67	110.4	0.432	0.205	0.567	0.00	0.00
5.15	16.90	**11.18**	**0.563**	5.04	0.576	115	19.41	2.94	6.09	118.1	0.433	0.233	0.643	0.00	0.00
5.2	17.06	**12.7**	**0.792**	6.24	0.580	115	21.88	2.96	6.29	137.7	0.433	0.323	0.888	0.00	0.00
5.25	17.22	**14.64**	**0.956**	6.54	0.585	115	25.04	2.93	5.96	149.2	0.434	0.389	1.069	0.00	0.00
5.3	17.39	**17.3**	**0.969**	5.60	0.589	115	29.37	2.83	5.02	147.3	0.435	0.377	1.035	0.00	0.00
5.35	17.55	**17.36**	**0.888**	5.12	0.593	115	29.26	2.80	4.79	140.2	0.435	0.336	0.921	0.00	0.00
5.4	17.72	**17.49**	**0.931**	5.33	0.598	115	29.26	2.81	4.89	143.2	0.436	0.353	0.966	0.00	0.00
5.45	17.88	**18.48**	**0.972**	5.26	0.602	115	30.70	2.79	4.73	145.1	0.437	0.364	0.995	0.00	0.00
5.5	18.04	**20.04**	**1.138**	5.68	0.606	115	33.05	2.79	4.72	156.0	0.437	0.433	1.181	0.00	0.00
5.55	18.21	**21.86**	**1.254**	5.74	0.611	115	35.80	2.77	4.53	162.3	0.438	0.477	1.301	0.00	0.00
5.6	18.37	**20.65**	**1.116**	5.41	0.615	115	33.58	2.77	4.55	152.8	0.438	0.412	1.121	0.00	0.00
5.65	18.54	**19.14**	**0.991**	5.18	0.619	115	30.91	2.79	4.67	144.3	0.439	0.359	0.977	0.00	0.00
5.7	18.70	**17.45**	**0.898**	5.15	0.624	115	27.98	2.82	4.94	138.2	0.439	0.325	0.883	0.00	0.00
5.75	18.86	**16.32**	**0.79**	4.84	0.628	115	25.99	2.82	5.00	129.9	0.440	0.284	0.770	0.00	0.00
5.8	19.03	**15.87**	**0.628**	3.96	0.632	115	25.10	2.78	4.61	115.7	0.441	0.224	0.606	0.00	0.00
5.85	19.19	**18.41**	**0.821**	4.46	0.637	115	28.92	2.76	4.49	129.8	0.441	0.284	0.767	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-3
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft
PGA: 0.40 g
Estimated Earthquake Magnitude: 7.0
Magnitude Scaling Factor: 1.19
Required FS: 1.0
Limiting Qc1n-cs for liquefiable soils: 164
Limiting Ic for liquefiable soils: 2.55
Total Estimated Settlement: 2.13

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{CIN}	Ic	Kc	$(Q_{CIN})_{CS}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
5.9	19.36	**47.88**	**0.978**	2.05	0.641	115	58.15	2.29	1.92	111.5	0.442	0.209	0.565	1.84	0.04
5.95	19.52	**67.22**	**1.431**	2.13	0.645	115	81.36	2.19	1.65	134.5	0.442	0.306	0.827	1.84	0.04
6	19.69	**37.27**	**1.58**	4.24	0.649	115	44.96	2.59	3.28	147.5	0.443	0.379	1.020	0.00	0.00
6.05	19.85	**30.63**	**1.408**	4.60	0.654	115	46.85	2.62	3.43	160.5	0.443	0.465	1.250	0.00	0.00
6.1	20.00	**23.26**	**1.023**	4.40	0.658	115	35.36	2.69	3.95	139.5	0.443	0.333	0.894	0.00	0.00
6.15	20.18	**22.49**	**0.796**	3.54	0.662	115	33.95	2.64	3.60	122.1	0.444	0.249	0.670	0.00	0.00
6.2	20.34	**36.32**	**0.807**	2.23	0.667	115	43.24	2.41	2.37	102.6	0.444	0.180	0.484	0.00	0.00
6.25	20.51	**32.16**	**0.829**	2.58	0.671	115	38.17	2.50	2.76	105.5	0.445	0.189	0.507	0.00	0.00
6.3	20.67	**25.33**	**0.95**	3.75	0.675	115	37.51	2.63	3.49	130.9	0.445	0.289	0.773	0.00	0.00
6.35	20.83	**18.24**	**1.051**	5.77	0.680	115	26.84	2.87	5.37	144.2	0.446	0.359	0.960	0.00	0.00
6.4	21.00	**16.23**	**1.106**	6.82	0.684	115	23.73	2.96	6.29	149.2	0.446	0.389	1.040	0.00	0.00
6.45	21.16	**16.55**	**1.035**	6.26	0.688	115	24.04	2.93	5.98	143.7	0.447	0.356	0.951	0.00	0.00
6.5	21.33	**17.44**	**1.033**	5.93	0.693	115	25.18	2.90	5.66	142.5	0.447	0.349	0.932	0.00	0.00
6.55	21.49	**17.46**	**0.991**	5.68	0.697	115	25.05	2.88	5.55	139.1	0.447	0.330	0.881	0.00	0.00
6.6	21.65	**17.71**	**0.888**	5.02	0.701	115	25.26	2.85	5.19	131.0	0.448	0.289	0.770	0.00	0.00
6.65	21.82	**18.59**	**0.856**	4.61	0.706	115	26.35	2.81	4.84	127.4	0.448	0.272	0.725	0.00	0.00
6.7	21.98	**19.92**	**0.892**	4.48	0.710	115	28.06	2.78	4.59	128.7	0.448	0.278	0.740	0.00	0.00
6.75	22.15	**21.19**	**0.954**	4.51	0.714	115	29.67	2.76	4.45	131.9	0.449	0.293	0.780	0.00	0.00
6.8	22.31	**22.25**	**0.896**	4.03	0.719	115	30.97	2.71	4.08	126.4	0.449	0.268	0.711	0.00	0.00
6.85	22.47	**24.06**	**0.824**	3.43	0.723	115	33.29	2.64	3.58	119.2	0.449	0.237	0.630	0.00	0.00
6.9	22.64	**24.71**	**0.755**	3.06	0.727	115	33.98	2.60	3.33	113.1	0.450	0.215	0.569	0.00	0.00
6.95	22.80	**24.92**	**0.692**	2.78	0.731	115	61.32	2.60	3.35	205.3	0.450	0.885	2.346	0.00	0.00
7	22.97	**25.55**	**0.722**	2.83	0.736	115	62.81	2.60	3.33	209.4	0.450	0.934	2.473	0.00	0.00
7.05	23.13	**27.1**	**0.783**	2.89	0.740	115	66.29	2.59	3.26	215.8	0.450	1.015	2.686	0.00	0.00
7.1	23.29	**26.21**	**0.811**	3.10	0.744	115	64.92	2.62	3.46	224.3	0.451	1.130	2.989	0.00	0.00
7.15	23.46	**26.9**	**0.787**	2.93	0.749	115	66.03	2.60	3.31	218.6	0.451	1.051	2.779	0.00	0.00
7.2	23.62	**27.81**	**0.778**	2.80	0.753	115	31.16	2.59	3.29	102.4	0.451	0.180	0.475	0.00	0.00
7.25	23.79	**28.37**	**0.797**	2.81	0.757	115	31.69	2.59	3.26	103.2	0.451	0.182	0.482	0.00	0.00
7.3	23.95	**27.78**	**0.944**	3.40	0.762	115	36.47	2.61	3.37	122.9	0.452	0.252	0.667	0.00	0.00
7.35	24.11	**30.67**	**1.063**	3.47	0.766	115	75.57	2.61	3.37	254.5	0.452	1.613	4.258	0.00	0.00
7.4	24.28	**28.18**	**1.08**	3.84	0.770	115	36.58	2.64	3.59	131.3	0.452	0.290	0.766	0.00	0.00
7.45	24.44	**26.76**	**0.86**	3.22	0.775	115	34.55	2.61	3.38	116.9	0.452	0.229	0.603	0.00	0.00
7.5	24.61	**28.26**	**0.937**	3.32	0.779	115	36.28	2.60	3.34	121.0	0.453	0.245	0.645	0.00	0.00
7.55	24.77	**24.35**	**0.84**	3.45	0.783	115	31.09	2.67	3.75	116.7	0.453	0.228	0.601	0.00	0.00
7.6	24.93	**23.97**	**0.799**	3.34	0.788	115	30.44	2.66	3.74	113.8	0.453	0.217	0.572	0.00	0.00
7.65	25.10	**33.41**	**0.822**	2.46	0.792	115	36.50	2.50	2.78	101.6	0.453	0.177	0.467	0.00	0.00
7.7	25.26	**29.97**	**0.85**	2.84	0.796	115	32.65	2.58	3.21	105.0	0.453	0.188	0.494	0.00	0.00
7.75	25.43	**25.84**	**0.979**	3.79	0.800	115	32.28	2.68	3.85	124.4	0.453	0.259	0.681	0.00	0.00
7.8	25.59	**25.32**	**1.012**	4.00	0.805	115	31.46	2.70	4.03	126.8	0.454	0.269	0.709	0.00	0.00
7.85	25.75	**24.82**	**1.194**	4.81	0.809	115	30.68	2.77	4.52	138.6	0.454	0.327	0.861	0.00	0.00
7.9	25.92	**32.23**	**1.419**	4.41	0.813	115	39.62	2.66	3.69	146.3	0.454	0.371	0.975	0.00	0.00
7.95	26.08	**68.99**	**1.855**	2.69	0.818	115	74.17	2.30	1.94	143.7	0.454	0.356	0.935	1.50	0.03
8	26.25	**104.05**	**2.11**	2.03	0.822	115	111.57	2.08	1.43	159.0	0.454	0.454	1.193	1.42	0.00
8.05	26.41	**116.93**	**2.035**	1.74	0.826	115	125.05	2.00	1.30	162.7	0.454	0.480	1.261	1.57	0.00
8.1	26.57	**125.76**	**1.942**	1.55	0.831	115	134.15	1.94	1.23	165.1	0.454	0.499	1.309	1.42	0.00
8.15	26.74	**129.3**	**1.152**	0.89	0.835	115	137.57	1.77	1.08	149.1	0.454	0.388	1.019	1.42	0.00
8.2	26.90	**128.05**	**1.065**	0.83	0.839	115	135.89	1.75	1.07	145.8	0.454	0.368	0.967	1.42	0.03
8.25	27.07	**93.23**	**1.106**	1.19	0.844	115	98.68	1.96	1.25	123.4	0.454	0.255	0.669	1.84	0.04
8.3	27.23	**70.21**	**1.152**	1.64	0.848	115	74.13	2.15	1.55	114.8	0.455	0.221	0.579	2.00	0.04
8.35	27.40	**54.24**	**1.229**	2.27	0.852	115	57.12	2.33	2.04	116.7	0.455	0.228	0.597	1.84	0.04
8.4	27.56	**44.9**	**1.414**	3.15	0.857	115	47.17	2.49	2.71	127.9	0.455	0.275	0.720	2.15	0.04
8.45	27.72	**40.09**	**1.264**	3.16	0.861	115	42.01	2.53	2.91	122.2	0.455	0.250	0.655	1.91	0.04
8.5	27.89	**37.12**	**0.986**	2.66	0.865	115	38.80	2.50	2.79	108.2	0.455	0.198	0.519	2.40	0.05
8.55	28.05	**39.73**	**1.045**	2.63	0.870	115	41.42	2.48	2.67	110.4	0.455	0.205	0.538	2.40	0.05
8.6	28.22	**42.77**	**1.131**	2.65	0.874	115	44.48	2.46	2.56	113.8	0.455	0.217	0.570	2.30	0.05
8.65	28.38	**45.09**	**1.12**	2.49	0.878	115	46.78	2.42	2.40	112.4	0.455	0.212	0.556	2.15	0.04
8.7	28.54	**52.98**	**0.895**	1.69	0.882	115	54.83	2.26	1.82	99.9	0.455	0.173	0.453	2.60	0.05
8.75	28.71	**56.79**	**0.959**	1.69	0.887	115	58.63	2.24	1.76	103.0	0.455	0.182	0.477	2.40	0.05
8.8	28.87	**61.78**	**0.987**	1.60	0.891	115	63.63	2.19	1.65	104.8	0.455	0.187	0.491	2.30	0.05

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-3
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: **3.5 ft** **Total Estimated Settlement:** **2.13**
PGA: **0.40 g** Required FS: **1.0**
Estimated Earthquake Magnitude: **7.0** Limiting Qc1n-cs for liquefiable soils: **164**
Magnitude Scaling Factor: **1.19** Limiting Ic for liquefiable soils: **2.55**

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{C1N}	Ic	Kc	$(Q_{C1N})_{CS}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
8.85	29.04	**68.42**	**0.986**	1.44	0.895	115	70.30	2.13	1.51	106.1	0.455	0.191	0.502	2.00	0.04
8.9	29.20	**73.78**	**0.904**	1.23	0.900	115	75.62	2.06	1.39	104.7	0.455	0.187	0.490	1.91	0.04
8.95	29.36	**82.1**	**0.754**	0.92	0.904	115	83.95	1.94	1.23	103.6	0.455	0.183	0.481	2.15	0.04
9	29.53	**86.93**	**0.709**	0.82	0.908	115	88.68	1.89	1.18	105.0	0.454	0.188	0.492	2.00	0.04
9.05	29.69	**91.47**	**0.773**	0.85	0.913	115	93.09	1.89	1.18	109.5	0.454	0.202	0.531	1.91	0.04
9.1	29.86	**97.8**	**0.782**	0.80	0.917	115	99.29	1.85	1.14	113.7	0.454	0.217	0.568	1.84	0.04
9.15	30.02	**106.36**	**1.764**	1.66	0.921	115	107.73	2.03	1.34	144.7	0.454	0.362	0.950	1.78	0.04
9.2	30.18	**86.25**	**1.788**	2.08	0.926	115	87.16	2.17	1.59	138.4	0.454	0.327	0.858	1.78	0.04
9.25	30.35	**33.16**	**1.223**	3.69	0.930	115	35.66	2.64	3.57	127.4	0.454	0.272	0.716	0.00	0.00
9.3	30.51	**31.66**	**0.667**	2.11	0.934	115	31.85	2.51	2.82	89.9	0.454	0.148	0.388	2.40	0.05
9.35	30.68	**32.93**	**0.573**	1.74	0.939	115	33.05	2.45	2.51	83.1	0.454	0.133	0.351	2.70	0.05
9.4	30.84	**30.69**	**0.605**	1.97	0.943	115	30.73	2.51	2.80	86.1	0.454	0.139	0.366	2.40	0.05
9.45	31.00	**31.3**	**0.633**	2.02	0.947	115	31.27	2.51	2.80	87.6	0.454	0.143	0.375	2.40	0.05
9.5	31.17	**31.27**	**0.677**	2.17	0.951	115	31.17	2.53	2.90	90.5	0.453	0.149	0.392	2.40	0.05
9.55	31.33	**29.85**	**0.822**	2.76	0.956	115	31.23	2.60	3.34	104.2	0.453	0.185	0.487	0.00	0.00
9.6	31.50	**28.92**	**0.94**	3.25	0.960	115	30.12	2.66	3.72	112.0	0.453	0.211	0.555	0.00	0.00
9.65	31.66	**26.63**	**0.944**	3.55	0.964	115	27.61	2.72	4.11	113.6	0.453	0.216	0.569	0.00	0.00
9.7	31.82	**26.09**	**0.938**	3.60	0.969	115	26.93	2.73	4.21	113.4	0.453	0.216	0.568	0.00	0.00
9.75	31.99	**25.28**	**0.919**	3.64	0.973	115	25.98	2.74	4.33	112.6	0.453	0.213	0.561	0.00	0.00
9.8	32.15	**28.68**	**0.907**	3.16	0.977	115	29.34	2.66	3.73	109.5	0.452	0.202	0.532	0.00	0.00
9.85	32.32	**30.21**	**1.058**	3.50	0.982	115	30.77	2.67	3.81	117.4	0.452	0.230	0.608	0.00	0.00
9.9	32.48	**32.97**	**1.255**	3.81	0.986	115	33.44	2.67	3.78	126.5	0.452	0.268	0.708	0.00	0.00
9.95	32.64	**33.07**	**1.382**	4.18	0.990	115	33.39	2.70	3.98	133.0	0.452	0.299	0.788	0.00	0.00
10	32.81	**28.61**	**1.304**	4.56	0.995	115	28.76	2.77	4.57	131.5	0.452	0.291	0.769	0.00	0.00
10.05	32.97	**23.86**	**1.13**	4.74	0.999	115	23.89	2.85	5.23	124.8	0.451	0.261	0.689	0.00	0.00
10.1	33.14	**19.75**	**0.967**	4.90	1.004	120	19.68	2.93	5.99	117.9	0.451	0.232	0.614	0.00	0.00
10.15	33.30	**19.14**	**0.952**	4.98	1.008	120	18.98	2.95	6.17	117.1	0.451	0.229	0.607	0.00	0.00
10.2	33.46	**18.12**	**0.982**	5.42	1.013	120	17.89	2.99	6.67	119.2	0.450	0.238	0.629	0.00	0.00
10.25	33.63	**18.58**	**0.862**	4.64	1.018	120	18.25	2.94	6.12	111.7	0.450	0.210	0.555	0.00	0.00
10.3	33.79	**19.67**	**0.931**	4.74	1.023	120	19.24	2.93	5.98	115.0	0.450	0.221	0.587	0.00	0.00
10.35	33.96	**22.64**	**1.337**	5.91	1.027	120	22.04	2.94	6.13	135.1	0.449	0.309	0.821	0.00	0.00
10.4	34.12	**24.71**	**1.308**	5.30	1.032	120	23.94	2.88	5.52	132.2	0.449	0.295	0.783	0.00	0.00
10.45	34.28	**104.08**	**1.04**	1.00	1.037	120	99.38	1.91	1.20	119.1	0.449	0.237	0.630	1.84	0.04
10.5	34.45	**79.81**	**1.11**	1.39	1.041	115	76.05	2.09	1.44	109.7	0.448	0.203	0.540	1.91	0.04
10.55	34.61	**43.57**	**1.402**	3.22	1.045	115	41.43	2.54	2.98	123.3	0.448	0.254	0.677	1.91	0.04
10.6	34.78	**26.55**	**1.182**	4.45	1.050	115	25.29	2.81	4.89	123.7	0.448	0.256	0.682	0.00	0.00
10.65	34.94	**19.17**	**0.814**	4.25	1.054	115	18.19	2.92	5.88	107.0	0.447	0.194	0.517	0.00	0.00
10.7	35.10	**17.67**	**0.753**	4.26	1.059	120	16.69	2.95	6.23	104.0	0.447	0.184	0.492	0.00	0.00
10.75	35.27	**18.93**	**0.845**	4.47	1.063	120	17.80	2.94	6.11	108.7	0.446	0.199	0.533	0.00	0.00
10.8	35.43	**20.2**	**1.121**	5.55	1.068	120	18.91	2.98	6.52	123.3	0.446	0.254	0.680	0.00	0.00
10.85	35.60	**23.72**	**1.092**	4.61	1.073	120	22.11	2.87	5.41	119.5	0.446	0.239	0.639	0.00	0.00
10.9	35.76	**53.69**	**0.812**	1.51	1.077	115	50.29	2.26	1.83	91.8	0.445	0.152	0.407	2.60	0.05
10.95	35.93	**85.16**	**0.551**	0.65	1.082	115	79.61	1.88	1.17	93.0	0.445	0.155	0.415	2.15	0.04
11	36.09	**80.23**	**0.75**	0.94	1.086	115	74.85	1.99	1.29	96.4	0.444	0.163	0.439	2.30	0.05
11.05	36.25	**51.74**	**0.983**	1.90	1.090	115	48.18	2.34	2.07	99.9	0.444	0.173	0.464	2.15	0.04
11.1	36.42	**28.54**	**0.817**	2.86	1.094	115	26.08	2.68	3.84	100.0	0.444	0.173	0.465	0.00	0.00
11.15	36.58	**18.23**	**0.502**	2.76	1.099	115	16.59	2.84	5.13	85.2	0.443	0.137	0.370	0.00	0.00
11.2	36.75	**14.73**	**0.461**	3.13	1.103	115	13.35	2.96	6.32	84.3	0.443	0.136	0.366	0.00	0.00
11.25	36.91	**13.55**	**0.485**	3.58	1.108	120	12.23	3.03	7.10	86.8	0.442	0.141	0.380	0.00	0.00
11.3	37.07	**15.55**	**0.49**	3.15	1.113	120	13.98	2.94	6.14	85.8	0.442	0.139	0.374	0.00	0.00
11.35	37.24	**16.71**	**0.526**	3.15	1.117	120	14.96	2.92	5.85	87.5	0.441	0.142	0.385	0.00	0.00
11.4	37.40	**18.15**	**0.642**	3.54	1.122	120	16.18	2.91	5.84	94.5	0.441	0.159	0.429	0.00	0.00
11.45	37.57	**19.96**	**0.672**	3.37	1.126	115	17.72	2.87	5.38	95.3	0.440	0.160	0.434	0.00	0.00
11.5	37.73	**20.49**	**0.691**	3.37	1.131	115	18.12	2.86	5.30	96.0	0.440	0.162	0.440	0.00	0.00
11.55	37.89	**19.31**	**0.878**	4.55	1.135	115	17.01	2.96	6.34	107.9	0.439	0.197	0.534	0.00	0.00
11.6	38.06	**31.73**	**0.805**	2.54	1.140	120	27.84	2.62	3.46	96.3	0.439	0.163	0.443	0.00	0.00
11.65	38.22	**94.94**	**1.35**	1.42	1.144	115	86.30	2.06	1.38	119.3	0.438	0.238	0.648	1.78	0.04
11.7	38.39	**65.87**	**1.57**	2.39	1.148	115	59.76	2.33	2.05	122.5	0.438	0.251	0.683	1.78	0.04
11.75	38.55	**60.41**	**1.815**	3.01	1.153	115	54.71	2.43	2.43	133.1	0.437	0.299	0.816	1.91	0.04

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-3
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table: 3.5 ft
PGA: 0.40 g
Estimated Earthquake Magnitude: 7.0
Magnitude Scaling Factor: 1.19
Required FS: 1.0
Limiting Qc1n-cs for liquefiable soils: 164
Limiting Ic for liquefiable soils: 2.55
Total Estimated Settlement: 2.13

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{CIN}	Ic	Kc	$(Q_{CIN})_{CS}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
11.8	38.71	**96.25**	**1.282**	1.33	1.157	115	87.00	2.04	1.35	117.5	0.437	0.231	0.630	1.78	0.04
11.85	38.88	**111.57**	**0.962**	0.86	1.161	115	100.66	1.87	1.16	116.6	0.437	0.227	0.621	1.84	0.04
11.9	39.04	**123.84**	**1.146**	0.93	1.166	115	111.52	1.85	1.14	127.7	0.436	0.274	0.748	1.71	0.03
11.95	39.21	**81.92**	**1.589**	1.94	1.170	115	73.63	2.20	1.67	122.9	0.435	0.253	0.692	2.00	0.04
12	39.37	**44.55**	**1.421**	3.19	1.174	115	39.97	2.55	3.03	121.3	0.435	0.246	0.675	0.00	0.00
12.05	39.53	**43.44**	**1.201**	2.77	1.178	115	38.90	2.52	2.86	111.3	0.434	0.208	0.572	2.00	0.04
12.1	39.70	**64.22**	**1.091**	1.70	1.183	115	57.41	2.25	1.79	102.6	0.434	0.180	0.496	2.40	0.05
12.15	39.86	**45.49**	**0.806**	1.77	1.187	115	40.59	2.38	2.23	90.6	0.433	0.149	0.410	2.40	0.05
12.2	40.03	**26.65**	**0.493**	1.85	1.191	115	22.37	2.62	3.47	77.6	0.433	0.123	0.340	0.00	0.00
12.25	40.19	**19.31**	**0.433**	2.24	1.196	115	16.15	2.80	4.79	77.3	0.432	0.123	0.339	0.00	0.00
12.3	40.35	**16.74**	**0.485**	2.90	1.200	115	13.95	2.92	5.93	82.8	0.432	0.133	0.367	0.00	0.00
12.35	40.52	**17.64**	**0.648**	3.68	1.204	115	14.65	2.96	6.36	93.1	0.431	0.155	0.429	0.00	0.00
12.4	40.68	**19.08**	**1.06**	5.56	1.209	120	15.78	3.05	7.29	115.0	0.430	0.222	0.614	0.00	0.00
12.45	40.85	**22.94**	**1.795**	7.83	1.214	120	18.90	3.08	7.69	145.3	0.430	0.365	1.013	0.00	0.00
12.5	41.01	**84.6**	**1.582**	1.87	1.219	120	74.51	2.19	1.63	121.8	0.429	0.248	0.689	0.00	0.00
12.55	41.17	**175.03**	**1.986**	1.14	1.223	115	153.88	1.80	1.11	170.8	0.429	0.543	1.513	0.00	0.00
12.6	41.34	**249.92**	**1.947**	0.78	1.227	115	219.33	1.58	1.00	219.3	0.428	1.061	2.958	0.00	0.00
12.65	41.50	**294.8**	**1.67**	0.57	1.231	115	258.27	1.43	1.00	258.3	0.427	1.682	4.695	0.00	0.00
12.7	41.67	**320.83**	**1.298**	0.41	1.236	115	280.58	1.31	1.00	280.6	0.427	2.134	5.965	0.00	0.00
12.75	41.83	**325.12**	**1.417**	0.44	1.240	115	283.84	1.32	1.00	283.8	0.426	2.207	6.176	0.00	0.00
12.8	41.99	**326.09**	**1.499**	0.46	1.244	115	284.19	1.34	1.00	284.2	0.426	2.215	6.207	0.00	0.00
12.85	42.16	**328.19**	**1.495**	0.46	1.249	115	285.53	1.34	1.00	285.5	0.425	2.245	6.301	0.00	0.00
12.9	42.32	**330.51**	**1.766**	0.54	1.253	115	287.05	1.38	1.00	287.1	0.424	2.280	6.409	0.00	0.00
12.95	42.49	**317.93**	**2.092**	0.66	1.257	115	275.65	1.46	1.00	275.7	0.424	2.028	5.709	0.00	0.00
13	42.65	**311.81**	**2.5**	0.80	1.262	115	269.88	1.53	1.00	269.9	0.423	1.908	5.380	0.00	0.00
13.05	42.81	**314.81**	**2.908**	0.92	1.266	115	272.01	1.57	1.00	272.0	0.422	1.952	5.512	0.00	0.00
13.1	42.98	**315.2**	**2.959**	0.94	1.270	115	271.89	1.57	1.00	271.9	0.422	1.949	5.513	0.00	0.00
13.15	43.14	**317.98**	**3.217**	1.01	1.275	115	273.82	1.60	1.00	273.8	0.421	1.989	5.635	0.00	0.00
13.2	43.31	**336.92**	**3.843**	1.14	1.279	115	289.64	1.62	1.00	289.6	0.420	2.340	6.638	0.00	0.00
13.25	43.47	**354.84**	**4.255**	1.20	1.283	115	304.53	1.63	1.00	304.5	0.420	2.707	7.691	0.00	0.00
13.3	43.64	**363.22**	**4.643**	1.28	1.288	115	311.20	1.64	1.00	310.5	0.419	2.865	8.155	0.00	0.00
13.35	43.80	**387.7**	**5.273**	1.36	1.292	115	331.62	1.65	1.00	332.3	0.418	3.493	9.957	0.00	0.00
13.4	43.96	**392.79**	**5.635**	1.44	1.296	115	335.42	1.66	1.01	340.0	0.418	3.734	10.662	0.00	0.00
13.45	44.13	**410.05**	**6.446**	1.57	1.301	115	349.57	1.69	1.03	359.9	0.417	4.415	12.626	0.00	0.00
13.5	44.29	**423.95**	**7.085**	1.67	1.305	115	360.82	1.70	1.04	375.1	0.416	4.989	14.292	0.00	0.00
13.55	44.46	**436.11**	**7.37**	1.69	1.309	115	370.56	1.70	1.04	384.7	0.416	5.376	15.427	0.00	0.00
13.6	44.62	**462.47**	**6.883**	1.49	1.313	115	392.31	1.64	1.00	391.0	0.415	5.637	16.203	0.00	0.00
13.65	44.78	**489.31**	**7.375**	1.51	1.318	115	414.40	1.63	1.00	414.4	0.414	6.698	19.285	0.00	0.00
13.7	44.95	**504.76**	**8.402**	1.67	1.322	115	426.79	1.66	1.01	432.2	0.414	7.590	21.888	0.00	0.00
13.75	45.11	**469.02**	**7.813**	1.67	1.326	115	395.92	1.68	1.02	405.6	0.413	6.285	18.157	0.00	0.00
13.8	45.28	**423.91**	**7.324**	1.73	1.331	115	357.26	1.72	1.05	374.9	0.412	4.981	14.415	0.00	0.00
13.85	45.44	**367.66**	**5.894**	1.60	1.335	115	309.36	1.72	1.05	326.1	0.411	3.306	9.584	0.00	0.00
13.9	45.60	**346.51**	**4.865**	1.41	1.339	115	291.09	1.69	1.03	300.7	0.411	2.608	7.572	0.00	0.00
13.95	45.77	**292.06**	**4.812**	1.65	1.344	115	244.96	1.79	1.10	269.9	0.410	1.909	5.552	0.00	0.00
14	45.93	**239.72**	**5.063**	2.11	1.348	115	200.73	1.93	1.22	245.0	0.409	1.448	4.219	0.00	0.00
14.05	46.10	**189.55**	**5.304**	2.80	1.352	115	158.47	2.09	1.44	228.3	0.409	1.187	3.465	0.00	0.00
14.1	46.26	**213.11**	**3.685**	1.73	1.357	115	177.88	1.90	1.19	211.0	0.408	0.953	2.787	0.00	0.00
14.15	46.42	**198.53**	**3.245**	1.64	1.361	115	165.45	1.90	1.19	196.5	0.407	0.786	2.303	0.00	0.00
14.2	46.59	**205.46**	**4.471**	2.18	1.365	115	170.96	1.99	1.28	219.1	0.406	1.058	3.104	0.00	0.00
14.25	46.75	**213.22**	**4.316**	2.03	1.370	115	177.13	1.95	1.24	219.8	0.406	1.068	3.140	0.00	0.00
14.3	46.92	**276.09**	**3.791**	1.37	1.374	115	229.00	1.75	1.07	245.3	0.405	1.452	4.277	0.00	0.00
14.35	47.08	**332.87**	**3.861**	1.16	1.378	115	275.66	1.64	1.00	274.8	0.404	2.010	5.932	0.00	0.00
14.4	47.24	**380.95**	**4.421**	1.16	1.382	115	314.99	1.61	1.00	315.0	0.403	2.987	8.829	0.00	0.00
14.45	47.41	**373.42**	**4.6**	1.23	1.387	115	308.28	1.63	1.00	308.3	0.403	2.805	8.307	0.00	0.00
14.5	47.57	**349.1**	**4.981**	1.43	1.391	115	287.76	1.70	1.04	298.9	0.402	2.564	7.606	0.00	0.00
14.55	47.74	**339.44**	**4.807**	1.42	1.395	115	279.36	1.71	1.04	291.1	0.401	2.375	7.060	0.00	0.00
14.6	47.90	**368.16**	**4.884**	1.33	1.400	115	302.53	1.66	1.01	306.3	0.401	2.752	8.195	0.00	0.00
14.65	48.06	**435.59**	**5.907**	1.36	1.404	115	357.39	1.63	1.00	357.4	0.400	4.325	12.906	0.00	0.00
14.7	48.23	**505.14**	**6.905**	1.37	1.408	115	413.82	1.60	1.00	413.8	0.399	6.670	19.940	0.00	0.00

Settlement Due to Liquefaction
(Saturated Sands)

Project No.: LE11210 **Sounding Location:** CPT-3
Project Name: Centinela Solar Powerline -- Calexico, CA

Depth to Water Table:	3.5 ft			**Total Estimated Settlement:**	2.13
PGA:	0.40 g	Required FS:	1.0		
Estimated Earthquake Magnitude:	7.0	Limiting Qc1n-cs for liquefiable soils:	164		
Magnitude Scaling Factor:	1.19	Limiting Ic for liquefiable soils:	2.55		

Depth (m)	Depth (ft)	Qc (tsf)	Friction (tsf)	Friction Ratio (%)	Effective Stress (tsf)	Estimated Density (pcf)	Q_{c1N}	Ic	Kc	$(Q_{c1N})_{cs}$	CSR	$CRR_{7.5}$	FS	Vol Strain (%)	Liquifiable Settlement (in)
14.75	48.39	546.2	8.138	1.49	1.413	115	446.77	1.61	1.00	446.8	0.398	8.374	25.079	0.00	0.00

APPENDIX E

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